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Develop Ingot Mold Foundry

In Addition to the Solid Molds Made in Dry Sand and Poured Vertically, Split Molds Are Made in Halves in Green Sand and Poured Horizontally

BY PAT DWYER

SOME men are born great, some achieve greatness and others have greatness thrust upon them. In a similar manner it may be said that some buildings are conceived, designed and erected as foundries, others gradually are adapted to the production of castings that differ widely from the original castings made in the early days; others, again, after perhaps having served a long and honorable career in another line of industrial activity, are converted into foundries. The Vulcan Mold & Iron Co., Latrobe, Pa., with a present capacity of 25 tons a day and an anticipated capacity of 50 tons a day when extensions now under way are completed, will fall within the third classification as outlined.

The buildings which house the various foundry operations formerly served in a similar capacity for a glass making unit. Due to certain circumstances which are of no interest at this time, the glass makers abandoned the plant and with the exception of a short time during the war when it was utilized in the manufacture of a certain war commodity, the plant remained idle until it was acquired by its present owner in the early part of 1923.

In certain respects the main building was adapted to foundry use. For example, the large excavation near one end which formerly contained the *lehr* or annealing oven, by slight changes has been converted into a convenient and serviceable pit where the solid molds are made, dried and poured. The cupola has been erected to one side of the main bay on the floor of this pit as shown in Fig. 2 and by this arrangement, the charging floor is brought into the desirable position of being flush with the foundry floor and also flush with the adjacent stock yard. The cupola in its present position is located close to one end of the building, but when the extension now under way is completed, the cupola will be located approximately the same distance from one end of the foundry as from the other. The solid molds which are made in a wide variety of sizes and shapes, closed and open top, Gathman, rectangular, square, conventional

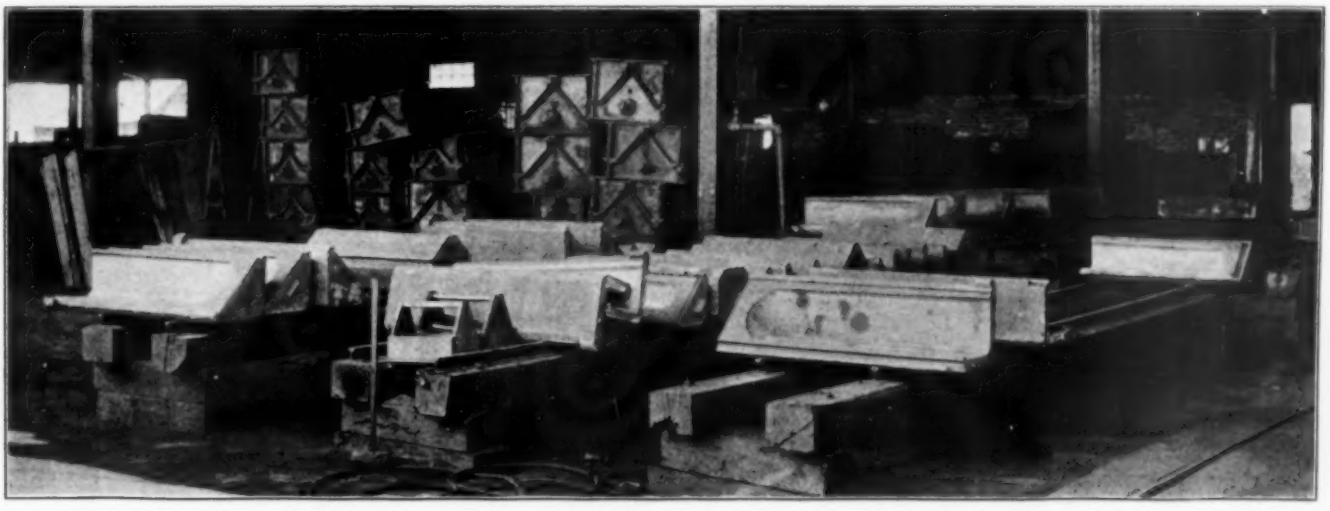


FIG. 1—SPLIT MOLDS ARE CLEANED ON SEVERAL SKIDWAYS THAT TERMINATE IN FRONT OF A SCALE AND SHIPPING PLATFORM—THE STYLE OF FLASKS EMPLOYED FOR MAKING THE MOLDS IS ILLUSTRATED IN THE PILE OF FLASKS BEHIND THE CASTINGS

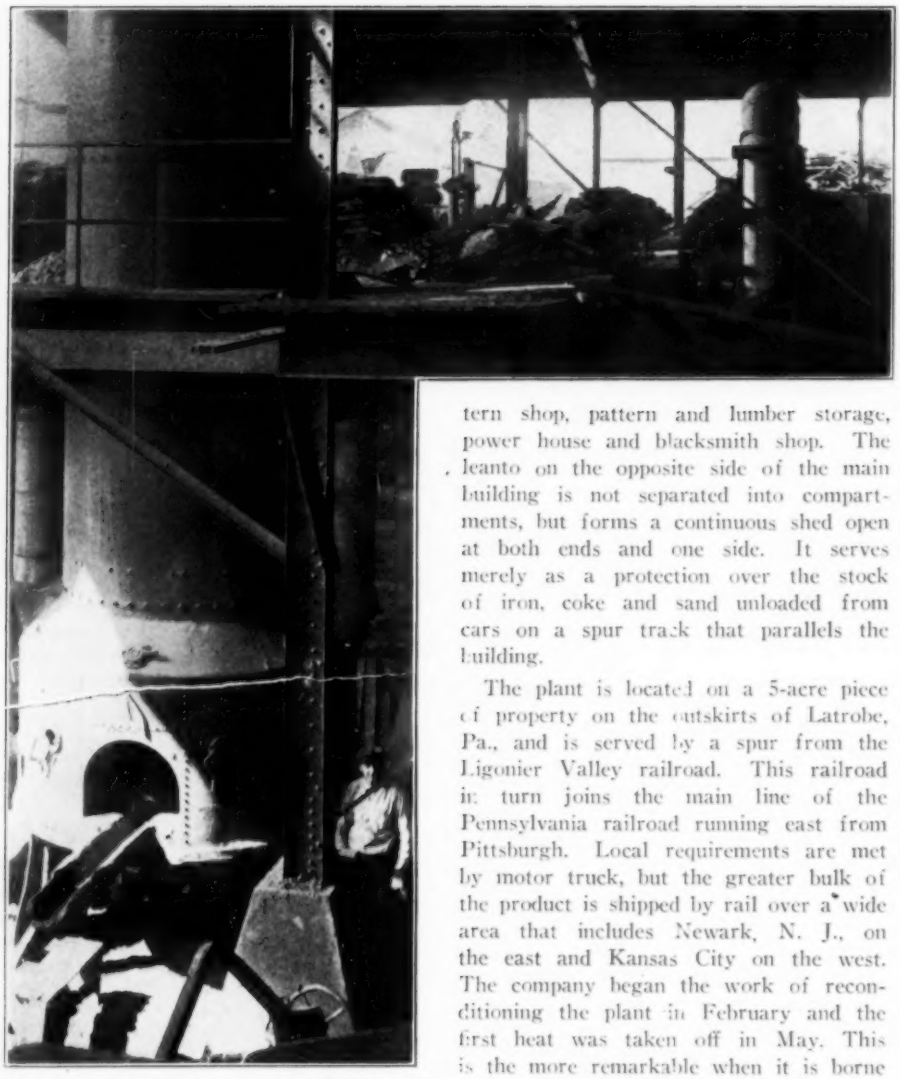


FIG. 2—THE CUPOLA IS ERECTED IN A PIT AND BY THIS ARRANGEMENT THE CHARGING FLOOR IS BROUGHT FLUSH WITH THE FLOOR OF THE FOUNDRY

and special many sided molds, always will absorb the greater part of the tonnage melted, but the comparatively lighter split molds and other miscellaneous castings including ingot stools, are expected to require a fair amount.

The relative position of the different departments together with the various pieces of mechanical equipment are shown in Fig. 4. The building is laid out in three main divisions. These include a central department 80 x 290 feet and two buildings adjacent, one on either side. One of these is 44 x 170 feet and the other 26 x 170 feet. The central division is the foundry proper where the molds are made and where the castings are poured, shaken out and cleaned. The buildings on either side house the contributory and auxiliary equipment. For example, the part of the building shown in the lower part of the illustration divided into various compartments by suitable brick partitions, contains the foundry office, machine repair shop, pattern shop, pattern and lumber storage, power house and blacksmith shop. The leanto on the opposite side of the main building is not separated into compartments, but forms a continuous shed open at both ends and one side. It serves merely as a protection over the stock of iron, coke and sand unloaded from cars on a spur track that parallels the building.

The plant is located on a 5-acre piece of property on the outskirts of Latrobe, Pa., and is served by a spur from the Ligonier Valley railroad. This railroad in turn joins the main line of the Pennsylvania railroad running east from Pittsburgh. Local requirements are met by motor truck, but the greater bulk of the product is shipped by rail over a wide area that includes Newark, N. J., on the east and Kansas City on the west. The company began the work of reconditioning the plant in February and the first heat was taken off in May. This is the more remarkable when it is borne in mind that a force of workmen had to be broken in as molders, chippers and cranemen in addition to the work involved placing additional steel frame work in the building to support the loads incident to extensive crane service.

Since practically all the flasks, core arbors, molds and castings are too heavy to be lifted by hand, cranes of various makes and capacities have been installed to facilitate the work in all departments. The ingot pit is served by a 10-ton crane made by the Shaw Electric Crane Co., Muskegon, Mich. The heavy, green-sand floor utilized principally for the production of heavy flask parts, arbors and other pieces of shop equipment is spanned by a 7½-ton crane supplied by the Pittsburgh Crane Co., Pittsburgh. One 2-ton crane in which the bridge was supplied by the Fawcus Machine Co., Pittsburgh and the hoist by the General Electric Co., has been mounted in each of the two bays devoted to the production of split molds and other miscellaneous related castings in green sand. The long bay at one side extending the full length of the main building, with the exception of that part occupied by the charging floor, is served by a 5-ton crane made by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. This bay is devoted to cleaning and chipping the solid molds. The planers at one end of the main building, the chipping racks and the loading station at one side are served by a light crane similar to that in one of the light green sand bays.

Methods and equipment for loading castings and unloading raw material are temporary and are being replaced by a yard crane spanning the railroad track.

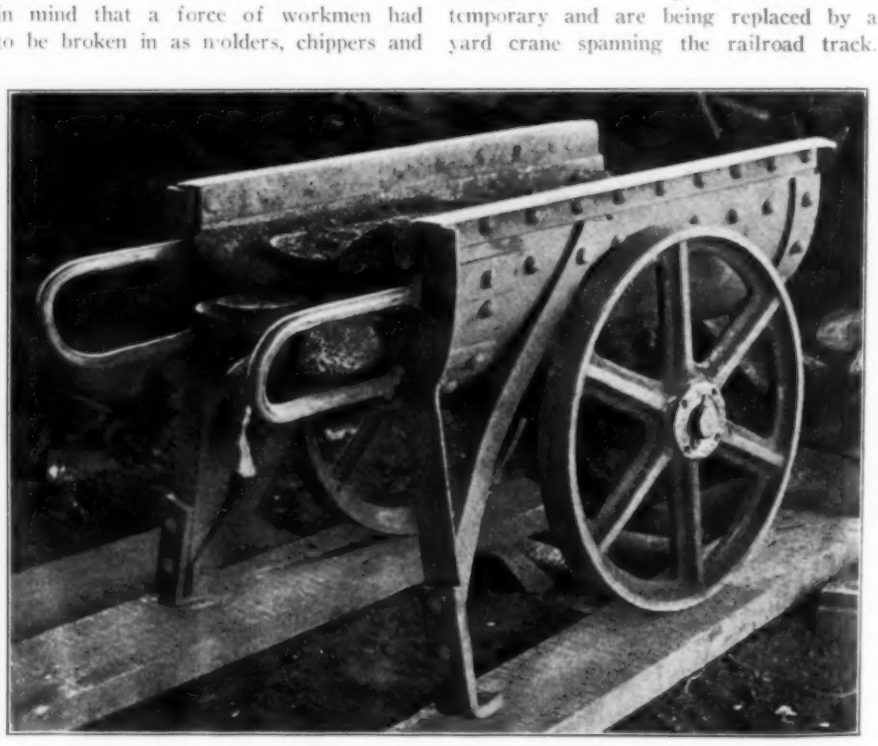


FIG. 3—THIS SPECIAL TYPE PIG IRON BARROW IS MOUNTED ON BALL BEARING WHEELS, HAS A CAPACITY OF OVER 1000 POUNDS AND IS HANDLED BY ONE MAN

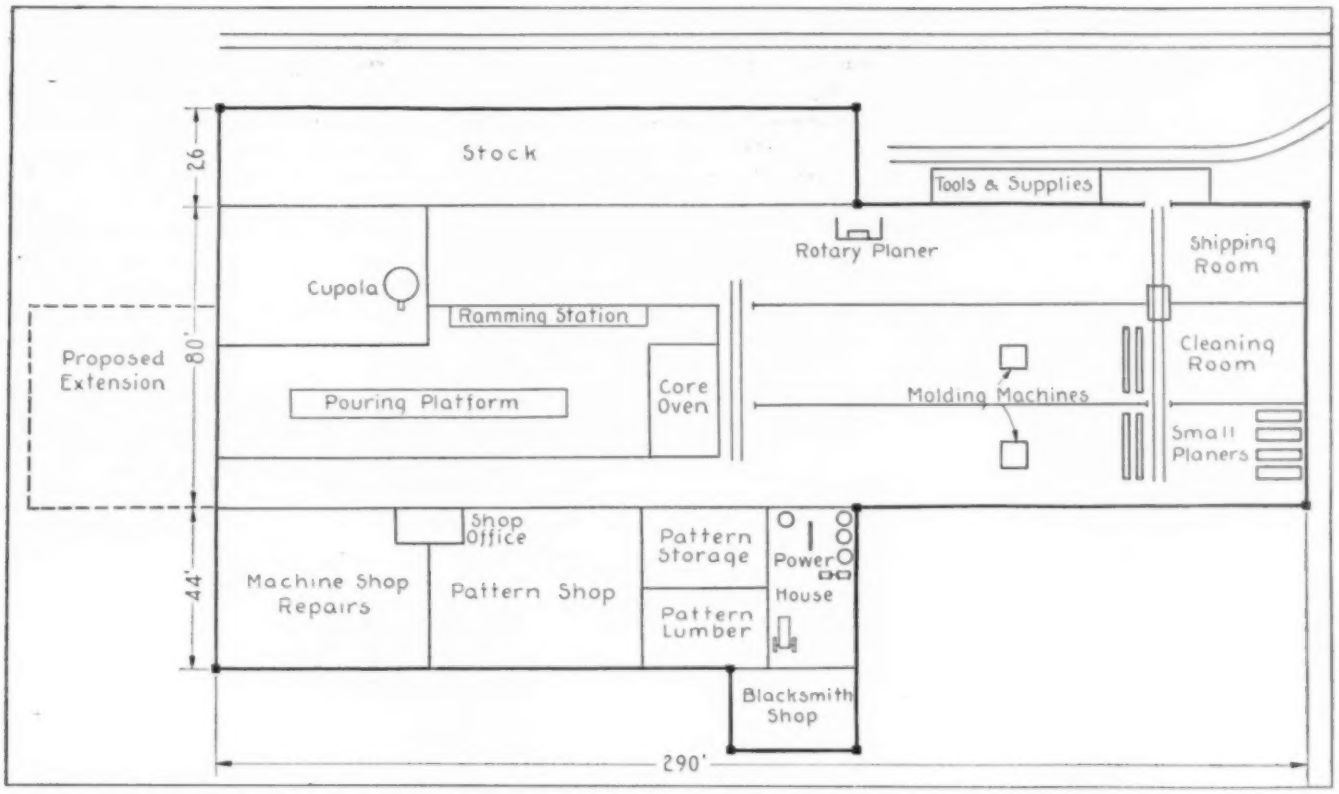


FIG. 4—FLOOR PLAN OF VULCAN MOLD & IRON CO. FOUNDRY SHOWING RELATIVE LOCATION OF THE VARIOUS DEPARTMENTS, APPLIANCES AND PIECES OF EQUIPMENT TOGETHER WITH THE PROPOSED EXTENSION TO THE INGOT PIT NO EXCAVATING WILL BE REQUIRED SINCE THE GROUND AT THIS END OF THE BUILDING IS ON A LEVEL WITH THE FLOOR OF THE EXISTING PIT

This crane will be equipped with magnet and bucket and will be available for loading castings for shipment, or for unloading pig iron, scrap, coke, limestone or sand directly from the railroad cars to the stock piles.

Electric current for light and power is supplied by the West Penn Power Co., a corporation that controls many distributing stations in western Pennsylvania. It is conveyed into the plant over heavy duty wires at 6600 volts and is stepped down to 220 volts through three transformers in the power house. A motor generator set near the transformers converts the alternating current to direct current. Air for the molding machines and pneumatic chipping tools is supplied by a direct driven compressor with a capacity of 300 cubic feet of air a minute, made by the Bury Compressor Co., Erie, Pa. Individual motors are employed to drive the various power tools including a 48-inch rotary facing machine, four flat planers ranging in size from 24 to 48 inches and the necessary tools in the pattern shop and repair shop.

The rotary facing machine is located close to where the solid molds are cleaned and is employed, as the name indicates, in facing the end of the mold to an accurate plane at right angles to an imaginary line drawn vertically through the center of the mold when in pouring position in the steel mill. The small flat planers are required to machine male and female joints on the adjoining edges of the split molds.

Ingot molds are divided into two classes known respectively as solid and split molds. The solid mold, as the name implies, is a solid one-piece casting from which the steel ingot either is pushed or bumped after it is cast. The split mold is made in halves in the foundry. Later, the halves are assembled in the steel mill and held in place by a loose band and a wedge. After the steel ingot is poured, the band and wedge are removed, the two halves of the mold are taken apart and the ingot is lifted out. The solid molds usually sit on cast iron stools provided for the purpose, but the split molds are closed at the lower end and may be set up on the floor of the steel melting depart-

FIG. 5—THE CHARGING FLOOR COVERED WITH CAST IRON PLATES IS FLUSH WITH THE FLOOR OF THE FOUNDRY AND THEREORE THE PIG IRON AND COKE MAY BE DISCHARGED DIRECTLY FROM THE RAILROAD CARS ONTO THE FLOOR OR ITS EXTENSION WHICH FORMS THE STOCKYARD

ment at any near or convenient point.

This foundry was established to cater particularly to the needs of the manufacturers of alloy steel and other forms of steel where the mill tolerances are held to close limits and consequently the surface of the cores in all cases, green or dry sand, is highly finished, so that the inside surface of the casting may present a satin-like skin.

An ingot mold simply is a piece of equipment with a life limit of not more than 150 heats and, therefore, no customer insists on a smooth and well finished exterior. However, since its active life and usefulness depend on two factors, a smooth skin on the interior, and the quality of the iron from which it is poured, these features receive the most careful and earnest attention. Several interesting points connected with molding of the castings are shown in the accompanying illustrations. At the time the photographs were taken the operating force still was engaged in the manufacture of foundry equipment in addition to a steadily increasing tonnage of ingot mold castings and that accounts for the somewhat disorderly general appearance of some of the areas illustrated. A new foundry in which only a few of the

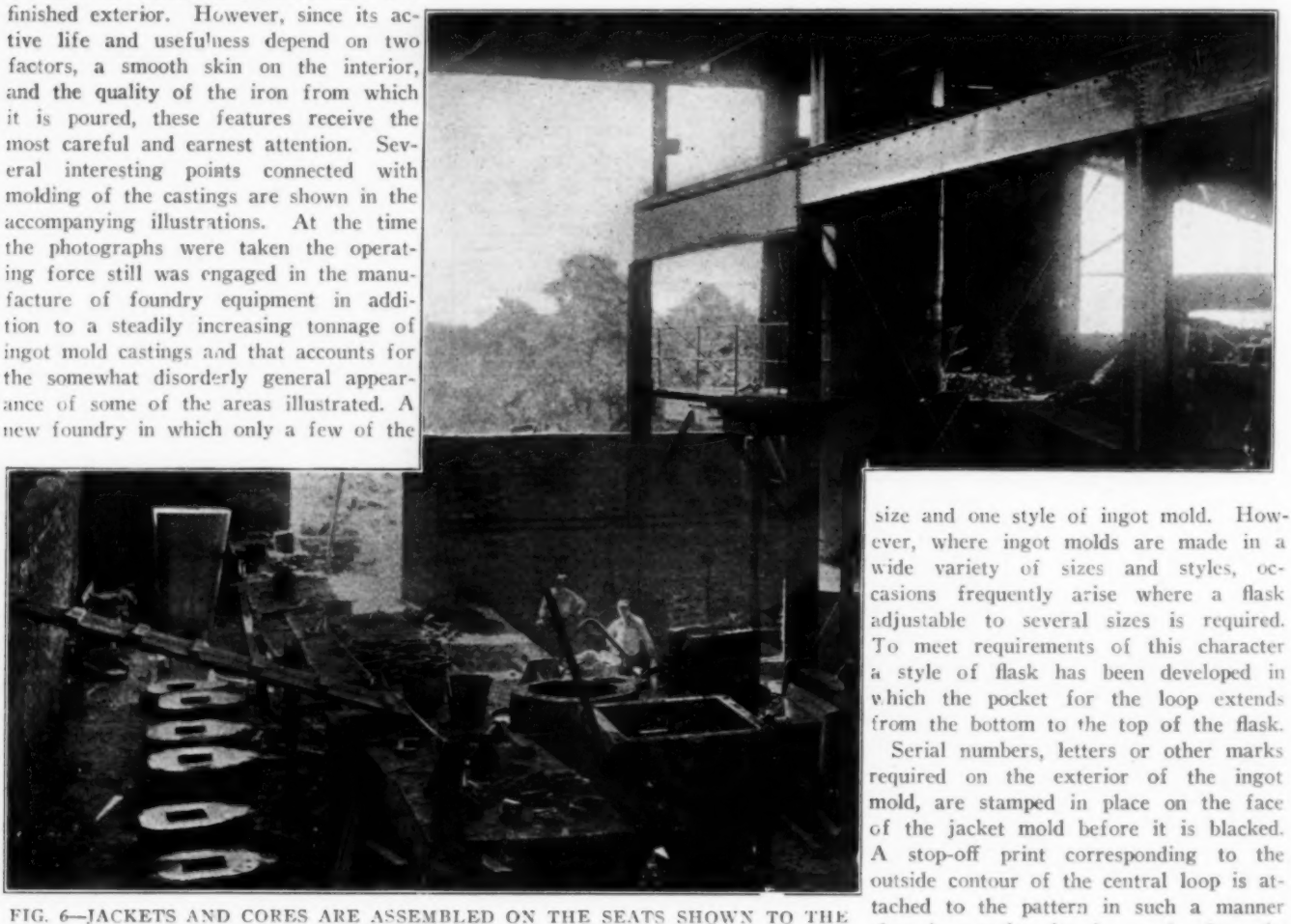


FIG. 6—JACKETS AND CORES ARE ASSEMBLED ON THE SEATS SHOWN TO THE LEFT

employes previously have had any foundry experience, cannot be whipped into shape in a minute.

The solid molds are made in a pit 80 x 30 x 9 feet. The jackets and cores are rammed side by side at the ramming station shown to the left in Fig. 8. The jackets are dried over a battery of fire places shown in Fig. 7 and the cores are dried suspended in the oven shown in Fig. 9. After they are dried the cores and jackets are assembled in a row on the seats shown to the left of Fig. 6 where they are poured. The platform is provided for the convenience of the men engaged in pouring the iron, skimming it and adjusting the loops in the top of the mold after it has been filled with iron. Occasionally a cope is placed on a mold, but as a general rule the molds are poured while open on top.

A coarse, open grade of molding sand from a bank in the Ohio river district is employed for both molds and cores. It is mixed in varying proportions of old and new sand depending to some extent on the condition of the available old sand and to a greater extent on the size and general character of the proposed molds. The object in all cases is to create a mold wall that is permeable to gas and yet that is hard, firm and smooth and sufficiently refractory to resist the heat of the molten iron. The face of the mold is covered with blacking which serves the double purpose of a refractory facing and also presents a smooth face to the iron.

The flask in which the ingot mold casting is made is split in two halves longitudinally. This form of construction facilitates shaking the casting and sand out of the flask after the casting has been poured. While in use the flask halves are held together by steel clamps and wedges. Loops are provided on the outside close to each end and form convenient handles by which to attach the hooks on the crane chains. On account of the rough treatment to which the flasks are subjected they are reinforced strongly with longitudinal and transverse flanges. Two typical flasks are shown in the center of the illustration Fig. 7. Suitable pockets are provided at one end to accommodate the lugs on the ingot casting. In the older type of flask, pockets similar to those shown at the side near the center of each flask were provided to receive the steel loop cast in the side of the ingot mold. This form of construction is quite satisfactory where the product is confined to one size and one style of ingot mold. However, where ingot molds are made in a wide variety of sizes and styles, occasions frequently arise where a flask adjustable to several sizes is required. To meet requirements of this character a style of flask has been developed in which the pocket for the loop extends from the bottom to the top of the flask.

Serial numbers, letters or other marks required on the exterior of the ingot mold, are stamped in place on the face of the jacket mold before it is blacked. A stop-off print corresponding to the outside contour of the central loop is attached to the pattern in such a manner that it remains in the sand after the jacket has been removed from the pattern. During the finishing process the print is extracted and replaced by the loop. The space between the two straight members of the loop then is filled with sand, rammed in place and slicked on the surface.

The jacket mold is placed temporarily over a vat filled with liquid blacking and a long handled brush is employed to paint the face of the mold. After the face has been blacked the jacket mold is lifted and placed directly over one of a long battery of fire places partly shown in Fig. 7. Coke is burned in these fires and also in the core oven adjoining where the cores for the ingot molds are dried suspended from the necks as shown in Fig. 9.

A limited variation from a fixed stand-

ard in sand mixture, ramming, or drying the jacket mold will not affect the resulting casting adversely; but conditions surrounding the making of the core are so sensitive that the least variation in material, method, or rigging invariably is reflected in the inside wall of the ingot mold.

The sand forming the core is rammed around a cast iron core barrel and the thickness varies to some extent depending on whether the core arbor is designed specifically for the mold in which it is employed, or is adapted to fit a mold of nearly the same size. The minimum thickness of sand is ¾-inch and the maximum rarely exceeds 2 inches. The core arbor is plentifully supplied with vent holes and where any doubt exists in the operator's mind, doubt that leads him to anticipate trouble from inadequate venting facilities, he places a long ½-inch rod close against each corner of the arbor. After the sand is rammed the rods are withdrawn, thus providing a clear passage for the vent at each of the four corners.

A certain degree of skill is required on the part of the man who rams the core and this part of the work is entrusted to men who have had more experience than those engaged in ramming the jackets. The sand must be rammed to a uniform density to insure a perfectly straight wall on the inside of the casting. If it is rammed too hard in spots it will scab and if it is not rammed hard enough it will wash in front of the gate. If the core is not sufficiently dried the steam will cause the sand to buckle on the surface while the mold is filling with iron. If the core is over dried and burned the sand will crumble away from the core arbor. From the foregoing it is apparent that ingot mold cores present a pretty problem that must be handled with care and delicacy.

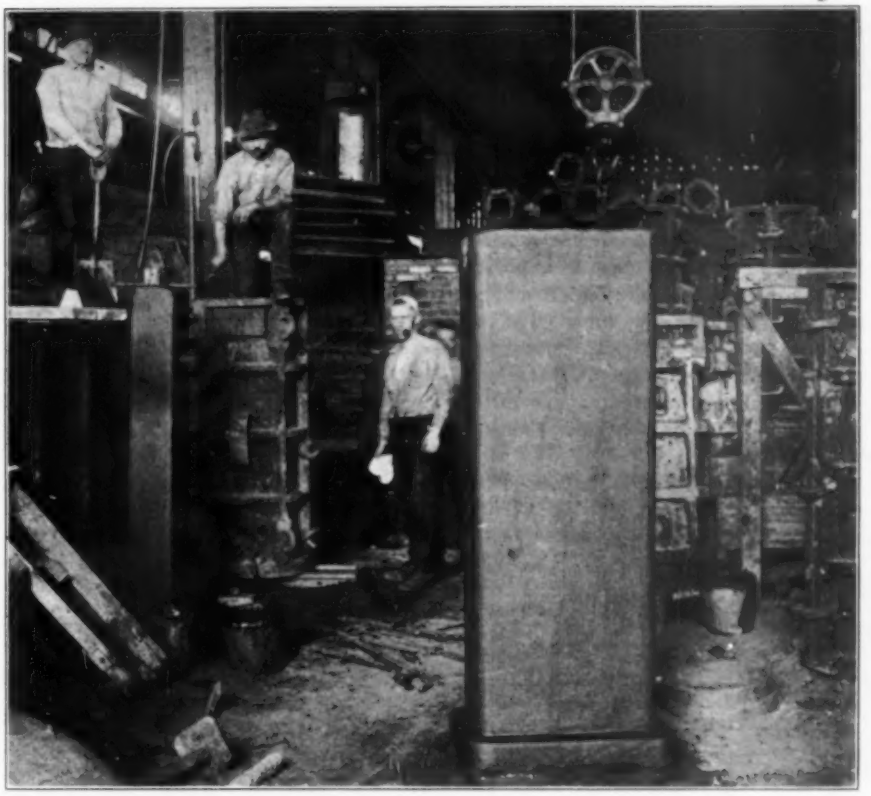


FIG. 8—MOLDS AND CORES ARE RAMMED AT ONE SIDE OF THE PIT CLOSE TO WHERE THE SAND IS PREPARED THE FACE OF THE MOLD SIMPLY IS BLACKED, BUT THE SURFACE OF THE CORE IS SLICKED AFTER IT IS BLACKED AND THEN PAINTED WITH THIN MOLASSES WATER

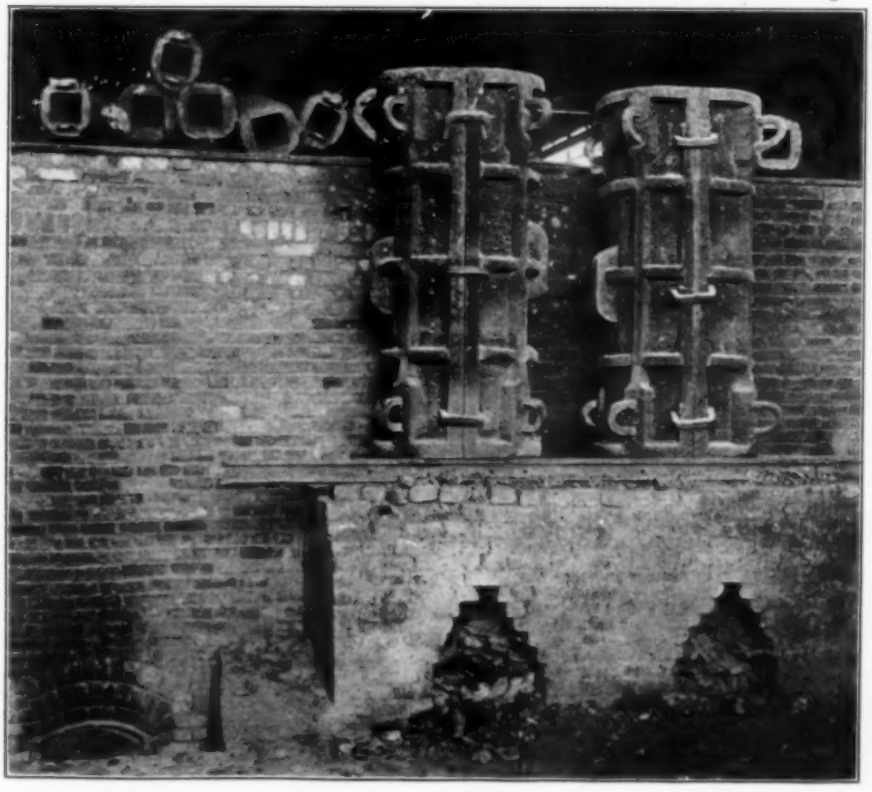


FIG. 7—THE BATTERY OF OPEN FIRE PLACES ON WHICH THE JACKETS ARE DRIED IS BUILT CLOSE TO ONE WALL OF THE OVEN IN WHICH THE CORES ARE DRIED

The core is rammed in a two-part corebox, split vertically through two diagonal corners. Where the size of the order warrants, the two halves are hinged along one joint, but for short orders, the two halves are made separately, provided with suitable dowel pins and held together with clamps. After the corebox is removed the core is lifted a short distance from the ramming station and there it is given a coat of blacking. The blacking afterward is slicked with a trowel and painted with a broad, camel-hair brush dipped in weak molasses water. As a result, the surface of the core is perfectly smooth and straight when it is suspended in the oven to dry.

One view of the core oven wall with the firing door almost concealed in the pit at the lower left of the illustration is shown in Fig. 7 and another view looking down into the almost empty oven is shown in Fig. 9. For want of any evidence to the contrary one may be justified in assuming that this style of oven is a logical outcome of the ingot maker's familiarity with the rolling mill

industry where his product plays such a prominent part. The oven corresponds in many features with the soaking pit in which ingots are reheated for rolling. It is compact, convenient and efficient and requires neither cars, rails or permanent roof. It is built in one corner of the pit with the top flush with the foundry floor and since only one side and one end wall are exposed, the thermal efficiency is correspondingly high. The floor of the oven is pierced with numerous small openings connecting with the flues underneath that extend from the firing chamber near one end to a chimney located some distance from the other end.

A step on the side walls about one foot from the top serves as a support for a number of rails laid in pairs. The green core is lifted by a bar engaged in two holes near the upper end of the arbor. The crane hook is attached to the center of the bar and after the core has been lowered between a pair of rails, a short steel clamp is slid along the rails on either side until the bar comes to rest. The crane then is disengaged and the core remains suspended until it has dried. The roof of the oven is formed by a number of cast iron plates which were cast in open sand molds and provided with four lifting loops for convenience in lifting them off and on. Occasionally large flat cores are placed in this oven instead of the regular oven provided for the purpose and dried as illustrated in the foreground of Fig. 9.

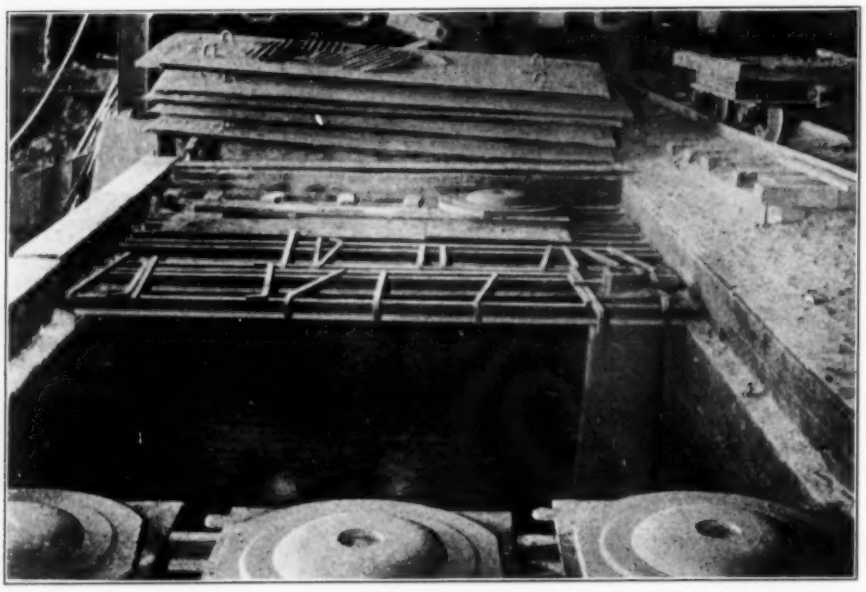


FIG. 9—THE OVEN OCCUPIES A SPACE BELOW THE FOUNDRY FLOOR LEVEL AND IS HEATED BY A COKE FIRE NEAR ONE END THE HEAT FROM THE FIRE PASSES THROUGH LONG FLUES AND IS CONDUCTED INTO THE OVEN CHAMBER THROUGH NUMEROUS SMALL OPENINGS PIERCED IN THE FLOOR THE CORES DO NOT REST ON THE FLOOR BUT ARE SUSPENDED IN THE MANNER ILLUSTRATED BY THE SINGLE EXAMPLE SHOWN

The dry sand molds are rammed by a pneumatic rammer provided with a special long extension and suspended from a counterweighted cord running over suitable pulleys which relieves the operator of the weight. The men work in pairs, one man shovels a steady stream of sand into the flask and the second man manipulates the rammer.

Split molds and miscellaneous jobbing castings are rammed in green sand molds, either by hand or on a pair of plain jolt machines supplied by the Osborn Mfg. Co., Cleveland. The method adopted depends on circumstances, including among other features, the relative number of castings ordered from any one pattern. Typical split molds and the flasks in which they are molded are shown in Fig. 1. The skidways on which the castings are cleaned are shown in the same illustration in the foreground.

Where the mold is rammed by hand, the pattern is placed convex side down in a follow board. The drag is set on the board and after the pattern has been covered with facing sand, a light thickness of heap sand is pressed by hand into the hollow of the pattern. A long ¾-inch vent rod is adjusted in the sand in such a manner that both ends project through holes provided in the ends of the flask for that purpose. The drag is vented with a wire in the usual manner before it is rolled over, but the long vent opening formed by the rod takes care of the greater part of the steam and gas generated while the mold is filling with iron. The casting is poured at the closed end through a gate at each side which delivers the iron at the lowest point of the mold. The iron is poured from a ladle into a basin on top of the cope. The basin discharges into a single runner in the cope which in turn feeds the two gates that extend from the top of the sand ridge in the drag to the bottom where they enter the mold. In addition to the facing sand the drag face of the mold is covered with soap stone facing rubbed on by hand, to produce a perfectly smooth surface on the inside of the casting.

Iron is melted in a cupola lined to 54 inches made by the J. W. Paxson Co., Philadelphia. A direct-connected, rotary pressure blower supplied by the same interest and delivering 6000 cubic feet of air per minute serves to bring the iron down at the rate of 10 tons per hour. Provision has been made in the roof and charging platform for a second cupola when conditions warrant.

Iron charges are made up in 2000-pound lots, 1200 pounds bessemer pig iron and the remainder foreign and domestic scrap. The bed charge of coke, 1200 pounds extends about 24 inches above the tuyeres and the amount of coke between the iron charges averages 225 pounds. Other combinations have been tried and the foregoing has proved most satisfactory. One cupola tender and two helpers do all the necessary work in preparing the cupola and charging it.

The charging floor which is on the same level as the foundry floor and stockyard is covered with cast iron plates and this feature greatly facilitates transferring the materials to the charging door. Coke is wheeled in a barrow of the ordinary foundry type and pig iron is wheeled in the special two-wheel, one-man truck with a capacity of 1000 pounds shown in Fig. 3. The materials are weighed on a scale set level with the floor in front of the column by the wheelbarrow in Fig. 5. Coke is forked and pig iron and scrap is thrown into the cupola by hand.

Pig iron is unloaded directly from the car to the charging platform on a gravity roller conveyor made by the Matthews Gravity Conveyor Co., Ellwood City, Pa. Scrap from the foundry is loaded in wheelbarrows, lifted by the crane and deposited on part of the charging floor which projects for that purpose beyond the cupola.

In connection with the bureau of standards, investigation of the enameling of cast iron, several typical castings have been received and have coated with representative enamels. This work is still in progress, and all the castings will be examined for blistering. Microphotographs will be made of the surfaces in order to detect any changes produced by the enamelnig operation. It is hoped that the cause of blistering of these castings will be discovered, and means developed to control and if possible eliminate it.

Cast Iron Alloyed with Nickel

Studies of Results Obtained by Additions of Nickel in Varying Percentages Are Offered—Hardness Increased and Grain Structure Made More Dense

BY PAUL D. MERICA

INTEREST of foundrymen producing gray iron castings has centered on the apparently paradoxical requirements of demands which certain castings must meet. Increased strength is sought without decreasing machineability. In the accompanying article Paul D. Merica, physical research department, International Nickel Co., Bayonne, N. J., offers some observations relative to the effect of nickel additions and advises how these should be made and what results may be expected. Dr. Merica, through his intimate association with this work and in the light of his former experience with the bureau of standards comments upon the possibilities and limitations of the nickel-iron alloys.

NICKEL was found useful as an alloying element in steel as far back as 1885, but its use in cast iron has been slow and is of comparatively recent origin. Of course, this has been due partly to the cheapness of cast iron. It was not thought that it could bear the cost of nickel addition, but it has been due also to the lack of knowledge among foundrymen about its effect on iron.

Today, cast iron is emancipating itself from its accepted role of poor cousin to steel, and much more care and attention, and what is more significant, expense, is devoted to its manufacture. It is not considered uneconomical today to use the electric furnace for iron for certain special purposes. Also, foundries do not consider chemical and physical control methods, an unwarranted expense, although they were considered highly extravagant some years ago. Therefore, it is not strange that renewed interest in the development of cast iron alloyed with nickel and other elements is evident.

Development of this subject has not proceeded to the point where all possible applications of nickel in cast iron can be foreseen. The International Nickel Co. is studying the matter, in its laboratories and it is hoped that through these investigations more light ultimately may be shed upon the matter. It is a complicated problem; the effect of nickel on iron depends upon the presence and amounts of other elements, upon the form of the carbon and other factors. Therein lies the explanation for the quite contradictory reports made by early investigators.

Although our knowledge of the subject is limited, it may be worth while to summarize what is known today and to describe some of the commercial applications of nickel cast iron.

Reports on this subject by several investigators* have agreed in some statements and disagreed in others. However, from a consideration of their results as well as of the experience of the International Nickel Co. and of others who have been engaged practically in the production of nickel cast iron the following statements seem to be warranted.

The presence of nickel in cast iron causes increased graphitic carbon formation; i. e., nickel tends, as does silicon, to gray the iron. This effect is quite definite but fairly mild; 1 per cent of nickel being equal perhaps roughly to from ¼ to 1 per cent of silicon in this respect.

The nickel does not form carbides, but dissolves in the ferrite of the iron. If the composition is such that combined carbon is present in the castings, this will be fine in structure in the presence of from 1 to 5 per cent nickel, and more resembling sorbite than pearlite, and in consequence harder.

Therefore, it will be seen that nickel exercises two effects quite opposite in nature, by lowering the combined carbon it softens the iron, but by sorbitizing the pearlite matrix of the iron, it hardens it. Which of these will prevail depends largely on the amount of combined carbon. If this is low in the composition of iron under consideration; i. e., if the iron is soft and open the nickel will soften it still further. If it is high, from 0.3 to 0.8 per cent, the hardening effect will predominate, as in fact it generally does in practice.

What has been said explains partly the disagreement of different investigators in commenting upon the effect of nickel on the mechanical properties of cast iron, and indicates also the difficulty of making general statements concerning it. The effect on mechanical properties gained by the addition of nickel, will depend upon the type of iron used; the latter may be hardened or softened, strengthened or weakened.

Grades of gray iron carrying from 0.50 to 0.85 per cent of combined carbon in general will be hardened, strengthened and toughened by the addition of from 1 to 5 per cent of nickel. Increases of from 15 to 40 per cent in hardness and in bending or compressive strength are thus obtained. The use of nickel often is beneficial, particularly in thin sections, in that good values of hardness may be obtained without incurring the risk of obtaining chilled or mottled iron or hard spots. The hardness obtained in gray iron by nickel additions is not due to an increase in the amount of carbide present, as it is when obtained by lowering the silicon content, with consequent attendant machining difficulties, but is due to the superior and finer form of the pearlite or carbide in the presence of nickel.

The effect of nickel may be illustrated by the records of tests of two sets of two heats each of iron, similar except for the presence of nickel. These tests are summarized in the accompanying table.

It is interesting to note that the ⅛-inch bars of melt No. 2 were mottled and brittle yet not as hard as the perfectly gray bars of melt No. 3 containing nickel.

The effect of the addition of from 1 to 5 per cent of nickel on the fluidity and the shrinkage of cast iron appears to be so slight as to be unappreciable. However, the addition of nickel appears to produce finer grain castings particularly in thin sections. The resistance to corrosion of nickel-bearing cast iron is somewhat superior to that of similar iron without nickel, but probably not sufficient to warrant its use generally to increase corrosion resistance. On the other hand, the resistance to oxidation at high temperatures is increased by the addition of nickel and some efforts have

*Piwowarsky and Eberfeld, Stahl und Eisen V 43 P 967; 1923.
Bauer and Piwowarsky, Stahl und Eisen V 40 P 1300; 1920.
J. E. Johnson Jr., Principles, Operations and Products of Blast Furnace; 1918.
W. H. Hatfield, Cast Iron in Light of Recent Research, 1918.
R. Moldenke, Principles of Iron Founding, 1917.
L. Guillet, Comptes Rendus, V 145 P 552, 1907.

been made to utilize this feature in a practical manner.

When nickel is used in connection with chromium, the combined effect of the two elements depends upon their relative amounts, but generally is in the direction of hardening and strengthening the iron and increasing its chilling power. Dr. Moldenke has made a study* of the effect of one particular combination of nickel and chromium found in a commercial pig iron made by the Bethlehem Steel Co., Bethlehem, Pa.

Making Nickel Additions

Nickel may be added either in the cupola or in the ladle. For the former purpose, nickel shot may be used, but it should be coarse, probably not under ¼ inch. A preferable form is that of 25-pound blocks which will not fall through the charge as shot will do. Amounts of nickel up to 5 per cent may be added in the ladle and readily absorbed. In this case finer shot is desirable, probably such as will pass a ¼-inch screen and this should be fed gradually into the stream of hot metal from the cupola spout.

More recently the International Nickel Co. has developed a grade of nickel shot for this purpose having a reduced melting point, which in consequence dissolves more quickly in the ladle metal.

If an electric furnace is used, the nickel may be included in the charge in the usual manner—using either shot or blocks.

Probably the earliest use of nickel in cast iron was for the production of steel mill rolls and pipe balls.

Nickel and nickel-chromium cast iron have won for themselves a definite place in the steel industry and the development of their use is still progressing. The rolls used in a steel mill can be classified as either sand cast iron, chilled cast iron, steel or alloy. The latter term almost invariably refers to a nickel or nickel-chromium cast iron, a large number of which are sold under a trade name. The range of analysis of such rolls will approximate, silicon 1.00-2.00; manganese, 0.40-0.75; carbon, 1.50 to 3.50; chromium, 0.75 to 1.50; nickel, 0.50 to 1.50. Such rolls are used for roughing, stranding and finishing. They are fitted by their hard surface, toughness and resistance to wear to the first two uses. A chilled roll is found more often in the finishing passes.

Other accessories used in the manufacture of steel are regularly made from nickel or nickel-chromium mixes. These include rolling mill guides, which perform the function of leading the steel into the proper pass of the mill; bending dies in a pipe mill which bend the skelp into position to be welded and pipe balls which support the skelp during the welding operation. A typical analysis for these purposes is as follows: Silicon, 1.50 to 2.50; manganese, 0.40 to 0.70; carbon, 2.75 to 3.25; nickel, 1.00 to 2.50; chromium, 0.75 to 1.25. This should be given a good anneal prior to use. In making seamless tubing similar uses are found for these materials in the piercing and drawing plugs, while a considerable tonnage goes into forging industry as hammer blocks. For all these purposes the situation demands a material which has a great resistance to wear together with strength.

Uses in Automotive Lines

The use of nickel cast iron for cylinder blocks and pistons of automobile engines was developed by the Cadillac Motor Car Co., Detroit, in an effort to improve the quality of these castings and to secure greater length of service from them. The idea of using nickel in the cylinders was due to J. J. Wilson, of the Cadillac company, and its development has been further promoted by H. B. Swan, superintendent of its foundries, through whose courtesy I am able to present a brief description of their experience and practice.

For the cylinders an iron is used containing from 1.75 to 1.90 per cent silicon and from 1.50 to 2.00 per cent nickel. Without the nickel addition the brinell hardness would average from 130 to 150. With addition of nickel the hardness can be increased to 175 to 200. This increase may, of course, be accomplished by other means, but with increased difficulty in machining. Inasmuch as these difficulties are eliminated by the use of nickel, the experience of the Cadillac company has been that it is economical to secure this hardness by the use of nickel.

From service tests of cylinders they have found that with the lower hardness a wear of from 0.0015 inch to 0.002 inch was obtained in 20,000 to 25,000 miles and the cylinders would need regrinding. With a brinell hardness of 175 to 200, however, the cylinders showed a wear of only from 0.00075 inch to 0.001 inch and did not need regrinding. This company credits this decreased wear not only to the hardness of the iron, but also to the fine grain and high luster finish which can be produced with addition of nickel. It has been found that the nickel cast iron cylinders at 200 brinell hardness machine as easily as the non-nickel bearing ones at 150 brinell.

Recent Tests

For pistons this company uses a 2.50 to 2.75 per cent silicon iron with about 1½ per cent of nickel. Without the nickel, the section of ⅛ inch is so thin that the iron would tend even with this high silicon content to be hard and mottled. The addition of nickel prevents the formation of any white iron, but produces a fine grain readily machineable iron.

In some recent tests in co-operation with another motor car manufacture, cylinders were cast with the regular mixture to which various amounts of nickel were added. The brinell hardness values on these cylinders indicate the effect of nickel:

	Brinell Hardness
Regular Mixture	141
0.89% nickel added	157
1.36% nickel added	170
1.89% nickel added	195

For certain special purposes nickel cast iron has been in use to a limited extent in the chemical industry. Because of the increased resistance to corrosion by alkalis a 3 per cent nickel cast iron has been used for melting pots in the naphthol industry* as well as for valves for special purposes.

The addition of ¾ per cent of nickel decreases the rate of oxidation of cast iron at higher temperatures and in consequence such iron has been used to a limited extent in the production of molds for copper castings as well as in the glass industry for bottle glass molds. Similarly such iron has been used for zinc-base, die-casting nozzles.

The Westinghouse Electric & Mfg. Co. uses a 5 per cent nickel cast iron in the production of electrical resistance

Effects of Nickel Additions

Melt	Per cent nickel	Per cent total carbon	Per cent combined carbon	Per cent silicon	Per cent manganese	Per cent sulphur	Per cent phosphorus	Brinell hardness 3000 kg.	Transverse strength in pounds	Deflect'n in inches	
8	3.7	3.63	0.45	1.45	0.58	0.032	0.09	192	3270(1)	0.126	(Arbitration bars
9		3.93	0.83	1.45	0.68	0.031	0.13	159	2690	0.146	(1¼" rd.
2		3.70	2.30	1.37	0.65	0.021	0.22	315	125(2)	0.090	(⅛" x
3	4.5	3.65	0.60	1.24	0.68	0.023	0.19	350	219	0.198	(¾" (flat bar

(1) 12" centers.
(2) 6" centers.

*Paper before the American Institute of Mining and Metallurgical Engineers, February, 1922.

*Farbenchemic by H. E. Fierz (1920) P 260.

grids.* The nickel raises the electrical resistance and improves the mechanical properties and toughness of the castings which are necessarily of thin section. The nickel addition eliminates the tendency for the formation of hard or chilled white iron and thus strengthens and toughens the casting. These castings carry about 2.50 per cent silicon and from 4 to 5 per cent nickel.

In combination with chromium, nickel is added in amounts of from ½ to 1½ per cent nickel and ½ to 1 per cent chromium to white iron used for crushing rolls and machinery, grinding plates, sand blast nozzles.

H. T. Force* recommends the use of a 0.10 to 0.25 per cent chromium 0.10 to 0.20 per cent nickel cast iron for chilled car wheels.

Although it is evident that our knowledge of nickel cast iron as well as our commercial use of it are today still limited, such compositions appear to offer real advantages for certain special purposes. The use of nickel alone appears to be justified when maximum hardness and fine grain are required for readily machineable gray iron, and particularly in thin sections or whenever the casting has both thin and thick sections.

The nickel chromium cast iron on the other hand appears to offer promise chiefly for chilled iron where maximum hardness is required but where the iron does not need to be machineable.

*Nickel in Iron Castings, D. N. Witman, 1921; paper before A. I. M. E. February meeting, also *Iron Age*, Aug. 25, 1921.

*Proceedings A. S. T. M., 1921.

Announce Sales Changes

Robert W. White, assistant general sales manager, Linde Air Products Co., New York, manufacturer of oxygen for welding and cutting, has been appointed general sales manager of the Carbide & Carbon Chemicals Corp. L. M. Zimmer, western sales manager of the former company, has been appointed assistant general sales manager to succeed Mr. White. Other changes made at the beginning of the new year in the executive personnel of the Linde sales organization include the appointment of E. E. Radcliffe, assistant sales manager, eastern division, Herman Ullmer, assistant sales manager, western division, and F. E. Stoppenbach, district sales manager, New York district.

Seine Immerses Floor of Paris Foundry

The floods in the river Seine, which reached considerable proportions at the beginning of this year, caused considerable damage to plants in Paris and surrounding districts. Among the establishments concerned were a large number of foundries of all descriptions. Those plants which are situated on or near the banks of the river were particularly affected, notwithstanding the measures which were taken after the 1910 flood to prevent trouble.

In certain cases plants were shut down for several days, and with the men employed on salvage and protection work, the output of the foundries was reduced and large quantities of sand and other raw materials were lost.

The accompanying illustrations were taken at the Etablissements Bonvillain et Ronceray at Choisy-le-Roi. The photographs were taken on Jan. 8, two days after the climax of the flood. All communications were cut off and the foundry was flooded. On Jan. 10, four tons of iron were poured. One ton was used in making castings and the remainder was poured into pigs to dry the sand.

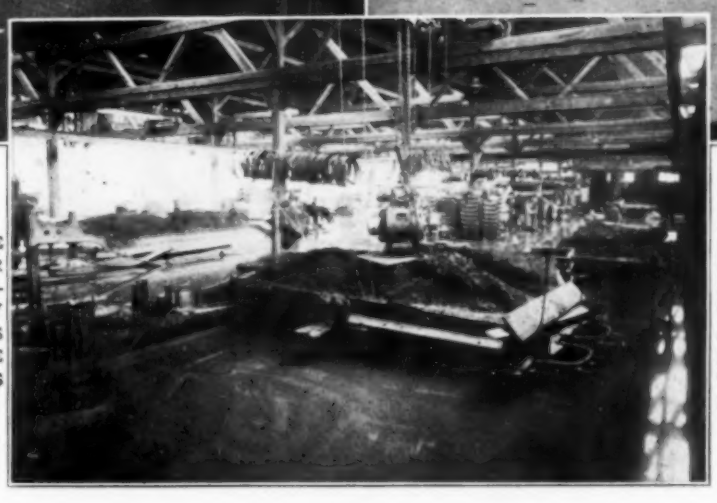
Among others, the Acieries de Vitry, a steel foundry, was also completely cut off and had to close down. After Jan. 10, work was resumed in most cases and production since that time gradually has been improving.

Eastern Supply Firm Holds Meeting

Whitehead Brothers Co. dealers in foundry sands, supplies and equipment, held their annual meeting in New York City recently and elected officers as follows: V. L. Whitehead Sr., chairman of the board of directors; Alfred J. Miller, president; Edward Whitehead, vice president; V. L. Whitehead Jr., vice president; George B. Walker, treasurer; J. H. Whitehead, secretary.

The board of directors was increased by the addition of V. L. Whitehead Jr., Buffalo, N. Y., manager of the western district and Charles E. Andrews, Providence, R. I., manager of the New England district.

ABOVE—ON JAN 8, THE LEVEL OF THE WATER REACHED 3 FEET—THE INTERIOR OF THE FOUNDRY WITH MOLDING MACHINES PARTLY FLOODED CAN BE SEEN THROUGH THE DOORS



ABOVE—GENERAL VIEW OF THE BONVILLAIN AND RONCERAY FOUNDRY PLANT AT CHOISY-LE-ROI—BOATS HAD TO BE USED TO GO IN AND OUT OF THE ESTABLISHMENT LEFT—INTERIOR OF THE FOUNDRY SHOWING MOLDING MACHINES PARTLY IN THE WATER

Shows Kinks in Brass Casting

Stopping Leaks First Step in Turning Loss Into Profit in Most Foundries—Knowledge of How To Buy Metal Important Asset in Successful Operation

BY. E. G. JARVIS

WE HAVE just started a new year, which on its very face promises great prosperity and January is a good time to eliminate bad habits. First tune up your pulleys in the grinding room, stop air leakages around your molding machines. If you have a concrete floor have your molder's helper sweep his stall at night and sprinkle the floor. You will be surprised at the increase in percentage of good castings. Have molding machines looked over regularly by a mechanic or toolmaker, as foundrymen know little about mechanics and there is no place where equipment gets such abuse as in the foundry. Stop shifts in your castings by having your iron boxes and flasks measured to a template once a month. Put stripping plates on your molding machines. This will decrease bad castings and increase sales due to sharper looking castings. Don't crowd your plates with patterns. My experience has been to put less patterns on plates instead of more. Pattern plates are not like street cars where there is always room for one more. Not everything is adapted to machine molding but a large percentage of jobbing work can be handled to advantage by aluminum match plates.

But of prime importance is the metal because the best sand, highest paid molders and most elaborate equipment cannot produce sound castings without good metal. Many foundrymen insist on buying scrap metals and making what they call their own mixtures. Composition scrap, most common of all, usually contains some valves, 85-5-5-5, some bushings and bearing, 80-10-10 or 78-15-7, some with and others without phosphorus, a little manganese bronze, 60-38, etc. with manganese, iron and aluminum, a trolley wheel now and then, and some railway car boxes, containing some copper and lead, a little tin, antimony and zinc, and cats, dogs and old rubber boots, yet a foundryman will tell you he makes his mixture out of 20 parts copper, 75 parts composition scrap and 5 parts yellow brass, and if you had an analysis of the material daily for a month, you would find the analysis varying from 75 to 88 copper, 2 to 7 tin, 3 to 12 lead, 1 to 5 zinc, in one heat phosphorus, in another manganese and in some everything, including iron, and yet day after day your machine shop complains about difficult machining qualities and tough metal. Yet the foundrymen fail to remedy the trouble at the source. In order to make good castings you must use metals and alloys of known quality. Don't doctor up your mixtures all the time. This is the worst habit I know of. In choosing a flux adopt one which will gather the impurities and bring them to the top so that they can be skimmed off and the flux pass off into the slag so as to leave no harmful effects in the metal. If your specifications are such that you can have some smelting company make your alloy to your formula you will use less melting time than with the new metal itself. Buying ingot alloy metals is the happy medium between using all new metals and scrap. Ingot compositions can always be bought a cent or more a pound below new metals. The chance of error in weighing the elements is eliminated, the melting point is lowered and uniformity is established, which is impossible to establish using scrap. The most experienced man in the sorting of scrap metal cannot sort miscellaneous scrap brass today with silicon bronze, manganese bronze, aluminum, bronze and the thousand different mixtures in vogue. I doubt if any two foundrymen present use exactly the same composition of metal. Some day we will probably standardize our mixtures and it will be found that 85 copper, 5 tin, 5 lead and 5 zinc will become the standard for red metal bronze for valves, fitting, pumps and pressure goods in general. This is an ideal mixture for bronze with a good red color and an easy alloy to cast, melt and machine. For bushings and bearings 80-10-10 has become more or less standard for railway work and some concerns use phosphorus for fluidity and to stop the lead from sweating out, while others say phosphorus makes the same alloy altogether too brittle for their requirements. However for closing up the grain, I have found nothing better in either 80-10-10 or 85-5-5-5 than cupronickel 50-50 shot, using ¼ pound to the hundred of alloy. This makes a decided improvement, especially in pressure goods such as plumbers' supplies. The manufacture of 50 copper, 50 lead has been quite a problem. For a number of years it had been customary to use sulphur to unite the two metals, but this did not stop sweating out of the lead. However, with varying percentages of cupro nickel 50-50 this problem has practically been solved.

Manganese bronze has always given foundrymen the shudders, both in ability to get good castings and to meet the high specifications. This is one alloy that I think cannot be made satisfactorily in ingots. You must buy the best copper, electrolytic or lake, not casting. Zinc must be horsehead or bertha, or like quality, free from lead, as lead as one element that must be absent to get the 70,000 tensile 32 per cent elongation required. Then make your own hardener from virgin aluminum, manganese copper, tin and iron and when your pure brass is molten add the hardener, soak for a few minutes and pour. Large gates and risers are essential as the alloy takes a great deal of feeding.

Nickel bronzes appear every day in some form or other, and everybody seems to try it once. Some succeed but the majority finally quit making this highly profitable product. To make nickel alloy castings the prime requisite is getting the metal hot. This can be done in any type furnace. I have produced ideal castings in crucible furnaces. Pour the metal just as soon as it leaves the fire. Put a little block of wood on the surface of the metal and let it burn while pouring. Sometimes the addition of a little zinc before pouring will raise the temperature if the metal gets slug-

From a paper presented at a meeting of the Indiana State Foundrymen's association, Lafayette, Jan. 17-18. The author is general manager, Niagara Falls Smelting & Refining Co., Niagara Falls, N. Y.

gish. Small molds must be skin-dried while large molds should be oven dried. Large gates and risers like those used for manganese bronze are necessary. I have obtained best results with lumberton sand and just a little albany or sand of like fineness, so as to give lots of vent.

Common yellow brass, 64-2-34, is a good alloy for some castings, but foundrymen instead of increasing the size of gates and runners, invariably put in aluminum to increase the fluidity. This is a foundry curse. Nothing has injured any branch of the business as much as aluminum in yellow brass. Check up your losses on melting gates containing a little aluminum and you will find almost always 10 per cent melting loss. Note the amount of skimmings off a pot containing a little aluminum. Smelters who buy borings always pay 1 cent a pound more for yellow borings free from aluminum. Some smelters will not take borings with aluminum. Aluminum alloys of one sort or another have developed to suit almost every requirement. Ninety per cent of the aluminum used is alloyed to produce No. 12 alloy, 92 per cent aluminum, 8 per cent copper. Foundries either buy this alloy in ingot form or buy virgin aluminum and add their own hardener, which is usually an alloy of 50 per cent copper, 50 per cent aluminum, which will melt readily in molten aluminum. This alloy usually can be bought cheaper than the small foundry can make it. It is made by melting the copper and adding the aluminum. Some foundrymen melt the aluminum first and add fine copper but this is not as good as melting the copper first. Zinc chloride is the usual flux for aluminum and a teaspoonful will gather all the impurities and leave the aluminum in excellent shape. The use of refined silicon in aluminum alloy produces better physical properties. An addition of 2 per cent silicon to No. 12 alloy will make up aluminum 90, copper 8, silicon 2. Such an alloy has physical properties somewhat superior to straight No. 12. It is practically free of viscosity, which characterizes straight No. 12 alloy and there is no hot shortness. Crystalline shrinkage is practically eliminated and castings show a fine dense crystalline structure.

To obtain high tensile strength and elongation it is necessary to increase the silicon. For such types I suggest aluminum 90 to 92 per cent, silicon 6 per cent, copper 2 to 3 per cent. A number of other alloys are desirable for a number of purposes. For instance, 5 silicon, 95 aluminum, has an added property of resistance to corrosion by salt water, weak alkali and acid solutions. Iron contents in all these alloys should be under 1¼ per cent as iron has a marked effect on ductility, increasing brittleness.

Treat your molds like your children. Feed them good food and lots of it if they are to do you credit. Don't forget the technical man. Every industry that either chemistry or metallurgy has entered has been greatly benefited by it. Take technical men into your business even though it takes them a year or sometimes two, to learn the practical side of the foundry business. But you have added in so doing an asset to your company, that money cannot buy.

How and Why in Brass Founding

By Charles Vickers

Hardening Yellow Brass

Can you advise us if yellow brass can be hardened without great expense? We have on hand a large amount of scrap such as brass pipe and brass rod which we want to use. The color of the alloy is unimportant. We have heard that nickel can be used as a hardener, but have no formula for using it, and will appreciate such information.

Yellow brass can be hardened by the addition of tin, and this is the method usually employed to harden it. Nickel will not harden brass in the same manner as tin, and it is not advisable to use it for this purpose. The most satisfactory manner of using the scrap is first to take stock of the different kinds, and then make a heat that will use all the different kinds of scrap in proportions to the amounts on hand. Thus if there is three times the amount of tubing as of rod, make a heat in that proportion, then take drillings from the ingots, mix them thoroughly and have an analysis made. This will indicate what the contents of the metal will be when mixed in the same proportions in future heats. Knowing the composition of the metal, it can be changed and brought to a standard formula. The following is advised:

YELLOW BRASS

	Per cent
Copper	68
Zinc	27
Lead	3
Tin	2

Should this alloy still be too soft, more tin can be added, as required.

White Metal Alloy

We have some foot grate castings to make and must use a white metal that will take a good polish, and also will withstand the salts of perspiration with the least possible amount of corrosion. These castings are used in electric cabinets for medical treatment, and in this connection aluminum is not suitable.

The following alloy should be satisfactory for the purpose outlined:

NICKEL BRONZE ALLOY

	Per cent
Copper	65.00
Nickel	32.25
Aluminum	2.75

What Is White Metal?

Has the common term white metal as used by foundrymen a different meaning from that applied by metallurgists, whose definition seems to center around babbitt metal? Isn't our ordinary understanding of the term white metal as meaning an alloy of tin and zinc at aproximately equal parts, and does this include the non-shrinking white metal ordinarily used for duplicating patterns?

The term *white metal* is applied indiscriminately to any metal or alloy that is white when machined. The old acceptation of the term was a bearing metal with a base of zinc such as Fenton's metal which consists of zinc, 80 per cent; tin 14.25 per cent; copper 5.5 per cent. These alloys were cast in sand molds just like brass, and the foundry *mixtures* were bronze, or red metal, yellow brass and white metal, and sometimes *pot metal* or *cock metal* mixtures of lead and copper. The tin and zinc pattern metal referred to, belongs to the class of the zinc base alloys and is a logical *white metal*, but the babbitts should not be classed as white metal, the term babbitt should.

and frequently is applied only to the tin base antifriction metals. *Antifriction metal* is a lead base alloy and is a cheap substitute for babbitt. It is not a white metal, but bluish. The tin base alloys are white, but if not termed babbitts they should be known as Britainnia metals, for they are simply modified Britannia metals.

Therefore, white metal is properly, a zinc base sand casting alloy containing tin and copper, and no aluminum, for this latter metal was unknown in those days, and to get good, heavy castings of this white metal in sand, minus a trace of aluminum required as skillful manipulation on the part of the foundryman as with any other alloy he used. Another white metal is called a bronze it is *Parson's white bronze.*

Causes for Porosity

We have experienced considerable trouble recently with our brass castings coming porous. We have tried various sands, and once in a while get a good casting among a lot of poor ones. We have used various means for cleaning and fluxing our metals, and have tried everything suggested, but still have the same trouble. All of our trouble is with stick bushings. After the castings are shaken out of the sand, they appear fine, and everything appears good even after the gate is cut off, but on machining into the casting itself, we find the holes.

Both the melting practice and the molding may be responsible for porous brass castings, therefore, it is exceedingly difficult to advise how to overcome such a difficulty unless all the facts in the case are made known. Thus, what kind of alloy is being used? How is it melted, and in what kind of furnaces? Are the bushings molded upright or horizontally? However, we will assume the trouble is caused by faulty melting. If crucibles and coke-fired furnaces are in use, instruct the melter to charge all the metal necessary to fill the pot when melted, at one time, when it is cold. This can be done by putting a deepener on top of the crucible and this deepener is simply the bilge cut from an old crucible and is set loosely on the coked-up pot. This permits all the heat to be charged at one time and avoids the evil of making additions of cold metal to liquified metal to fill the crucible. Put 2 ounces of phosphor copper in the bottom of the pot. Then charge the copper and the brass that goes with the heat. Scatter in some charcoal, or put in some small blocks of hard wood, a little lime and a pinch of salt and melt down rapidly. Then add the white metals, stir thoroughly and the melt will be ready to pour.

High Pressure Mixtures

We are sending for your inspection, a casting of a high pressure plunger oil pump body, which we have slit into a number of parts for better examination. This casting is to withstand a working pressure of from 2500 to 4000 pounds, and we are using a government bronze mixture as follows; copper, 88 per cent; tin, 10 per cent; zinc, 1.5 per cent, and lead, 0.5 per cent, the latter being added to help in machining. We mold this casting in two part flasks as is usual, then secure the two halves with a clamp and upend it, pouring down the holes in the end. The casting is thus poured on end, the gate descending to below the casting then horning in. On the highest part we put a shrink ball to feed the shrinkage. The castings after being machined show when tested with the testing compound, slight leaks through the walls, which are as a rule around the joint of the light ribs and the body part. The castings are cast solid, not being cored out, and we suspect the leakage is due to shrinkage and oxidation, the most of it being oxidation. We intend to use a mixture containng phosphorus, to overcome the oxide. We desire your opinion on the entire subject.

First as to the alloy. When 88-10-2 is modified by adding lead, better results are obtained when the lead content is taken from the tin, instead of from either the copper or the zinc. The alloy thus becomes copper, 88 per cent; tin, 9.5 per cent; zinc, 2 per cent, and lead, 0.5 per cent. The addition of 1½ ounces of phosphor copper per hundred pounds is sufficient to deoxidize the alloy when made from ingot copper melted in crucibles under charcoal. The pouring temperature for these rather heavy castings using this alloy should be around 2100 degrees Fahr. As far as the metal is concerned this will give sound castings.

In gating the castings, bottom pouring as at present is commendable, but change the horn to avoid the fountain effect it produces, the liquid spurts upward into the mold cavity and falls back just like a fountain. This is likely to entrap air, also the falling droplets are oxidized within the mold. To feed a casting as it solidifies the riser or feeder must set after the casting, otherwise it does no good. To set last, the mass of metal in the feeder must be larger than the part it has to feed and it must be connected to the casting by a large opening. In this case the same size as the top of the casting, or slightly smaller will be correct. If the casting is made solid, a shrink ball should be placed on the top of each of the three solid body parts, but it would be better to core out the two small body parts.

Another good way of making this casting would be to pour it horizontally with one end tilted by setting it on a piece of two by four. Run the gate with its runner down the mold so the metal enters at the lower end, and from the end of the central heavy part takes off a 2-inch riser which will be filled last. Put on a high cope by molding on an upset, and for a last suggestion if the phosphorus in the metal fails, leave it out. Use instead 1 per cent yellow prussiate of potash. Wrap this in paper and drop it on the surface of the metal and when it ceases to boil, stir it in. This will densify the metal.

Reclaiming Copper

We understand that in some western states, copper is being reclaimed from water that carries no more than 0.2 per cent. We believe scrap iron and old cans are used but have no definite information. In our reclaiming work with a concentrator and table we are unable to do better than about 1 per cent, and would like to know if we could reclaim more by some additional process.

Copper can be entirely reclaimed from a watery, acid solution by the addition of metals that are electro-positive to copper, of which iron is the cheapest. It is necessary though to get the copper into solution and whether this could be done profitably with the material it is desired to reclaim is the problem to be solved. If the gangue is alkaline, the use of acids to dissolve or leach out the copper is not feasible because the acid would be neutralized. It is quite easy to run tests and from the tests figure the costs. The reclaimed copper would be in a finely divided condition in which state it is not easy to melt without excessive loss from oxidation.

Either dilute sulphuric or hydrochloric acid will dissolve the copper and can be used in preference to nitric, if found more economical.

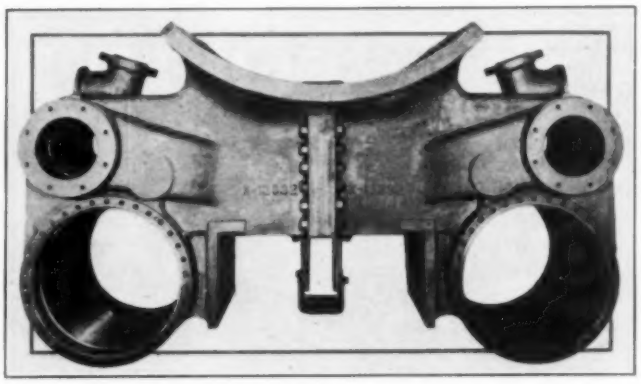
Cites Tablet Mixtures

We have orders for bronze tablets to be made of United States bronze mixture. Can you give us this formula? We also have other castings to make that must be pickled and we desire to get a formula suitable for these.

When government bronze is mentioned, the alloy copper, 88 per cent; tin, 10 per cent and zinc, 2 per cent is understood. However, this alloy seldom is used for tablets and a more suitable mixture would be copper, 89.50 per cent; lead, 0.50 per cent; tin, 5 per cent, and zinc, 5 per cent. The following alloy can be pickled; copper, 85 per cent; zinc, 10 per cent; tin, 3 per cent; lead, 2 per cent.

Making Locomotive Castings--III

Supervision by Contractors



Plan Shows Central Stock Bay

BY H. E. DILLER

WHILE the molding methods and equipment of the Baldwin foundry, as described in the two previous articles, are unique, the organization and handling methods are just as important to the successful operation of the shop. Intimate supervision is the keynote of the organization plan. This is obtained through the contract system in vogue—not contract labor, but contract supervision. A general foreman is in charge of the shop which is divided into three divisions, the heavy, medium and light work sections, each under a contractor who has from two to four assistants. The several foremen are on a salary but the contractors are on the weight basis. The staff is comprised of three salaried foremen and twenty-eight contract supervisors. This includes yard, cupola, cleaning, core making and molding. In addition, four inspectors pass on the finished work and follow it through the shops. All of these executives are paid according to the weight of good castings produced. The molders' wages are set by the general foreman in consultation with the contractors and the price paid to the contractors per pound of castings is regulated by conditions of labor and the price of iron. Then having the molders' wages set and the price per pound of good castings to be paid contractors it is to their interest to see that the molders work to the best advantage and lose as few castings as possible. The assistant contractors circulate among the molders helping and instructing them.

THE story of the Baldwin foundry would not be complete without a study of the method of supervision and the steps taken to supply molders through training the laborers to take the higher positions. These points are dwelt upon in this final article of the series. The layout of the plant, with its central stock bay and nine cupolas, is described, together with the methods employed in handling the stock, molds and castings.

Each division operates as a unit, independent of the others, and the contractor has charge of the orders, giving the pattern to the proper molder and keeping track of the time of delivery in his office. He knows when every casting must be made, as when an order for engines is received the dates of delivery to the machine shop of all the castings for the order are determined

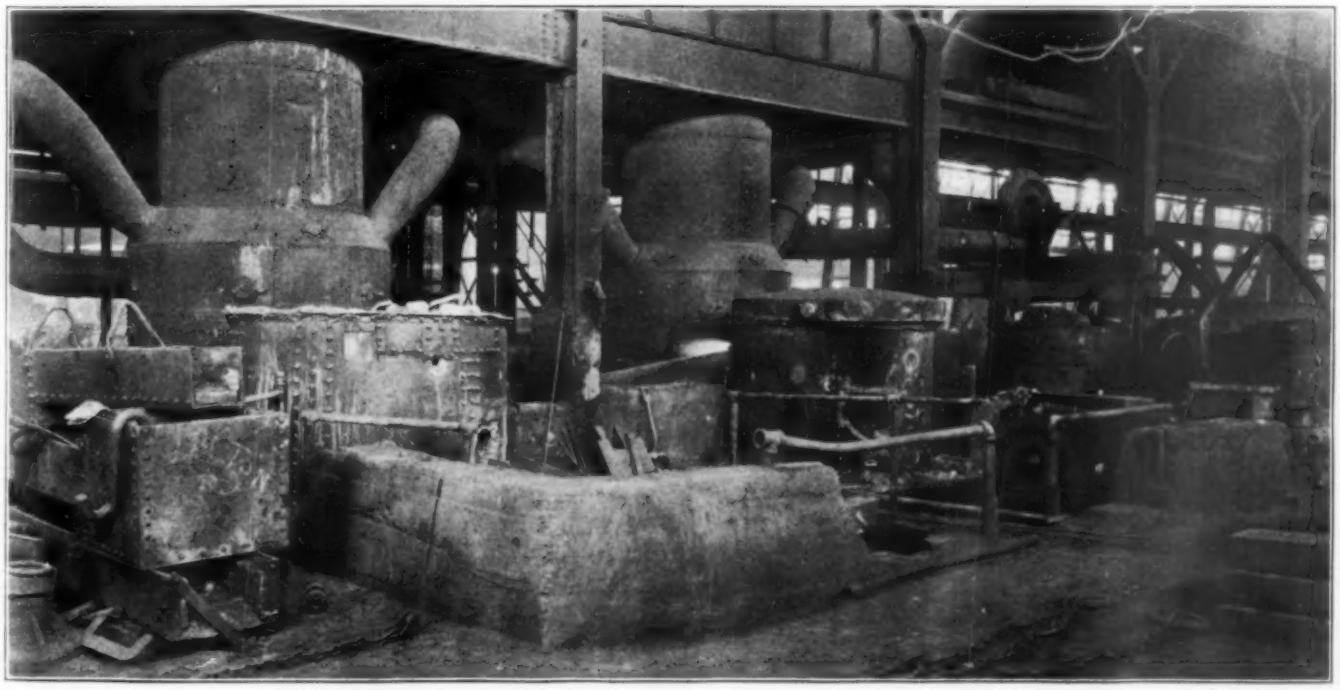


FIG. 1—TWO OF THE CUPOLAS ARE PROVIDED WITH FOREHEARTHS—THE ONE ON THE RIGHT IS IN OPERATION, WHILE THE OTHER IS BEING PREPARED FOR THE NEXT HEAT—NOTE THE INDIVIDUAL BLOWER ON THE CUPOLA AT THE RIGHT

FIG. 2—ONE OF THE APPRENTICE SCHOOLS IS LOCATED IN THE CENTRAL STOCK BAY

and the contractors are notified as to when the castings must leave their departments.

The best molders are promoted to be subcontractors, and the molding force is kept up by training laborers to be molders' helpers and when they become expert giving them work as molders. When these men are learning they are given work in a school where they are taught the methods of molding used in the section to which the school is attached, each of the three divisions of the foundry having its own school. One of these schools is shown at the left, Fig. 2. Here colored laborers are taught the rudiments of molding and graduate to the main foundry in a short time.

As noted in the first article of this series, the laborers who are being taught molding are put to work making grate bars which are hand rammed, for the company believes that a molder should have a good schooling in ramming and dressing molds even if he is to be placed exclusively on a floor where the molds are jolt rammed. The grate bar has been found a convenient casting to give the apprentice familiarity with the fundamentals of molding. The idea is to give the apprentice confidence. To the uninitiated the grate bar looks like a complicated affair, and when a green hand finds that all he needs to produce this complicated casting is a pattern, a wooden box, some sand and a rammer, his confidence is established and he does not look upon molding as beyond his ability. Confidence leads to ability.

The pattern shop which is quite large, employing as high as 500 patternmakers, also has a system of training. Boys from the Chester high school and the Williamson trade school are taken in the pattern shop for alternate periods of two weeks, thus the boys get two weeks school training and two weeks shop practice alternately throughout the year. It is rather significant that while the pattern shop usually has about 30 boys in training from the schools the foundry does not prove attractive to high school boys and must secure its molders from training common labor.

The relation of the pattern shop to the foundry has a marked effect upon the success of the Baldwin shop. This

FIG. 3—PIG IRON IS CARRIED TO THE CHARGING PLATFORM IN BUGGIES BY THE CRANE

relationship has been established with a view to promoting harmony and securing results. The pattern shop is regarded as subservient to the foundry and its whole effort is to aid through co-operation. The patternmaker foremen are in constant touch with foundry operations, not being satisfied that the pattern is finished according to drawing, but following it into the shop and consulting with the contractors about it. Thus if the contractor wants any change made he can learn from the patternmaker foreman why the pattern was not made in that way in the first place and may learn from the patternmaker's viewpoint why the change he proposes would not benefit. On the other hand the patternmaker becomes familiar with the foundryman's problems and sees pattern making from the molder's viewpoint.

By the system in vogue in the foundry more supervision is given than is customary in many other shops, but it has been found economical to have plenty of supervision, which is dependent on results for the amount of pay received. Also it is felt that an expert molder can benefit the company more as a supervisor than by actually working on the floor or operating a molding machine. With plenty of supervision the molds are watched as they are being made and defects corrected, or if a certain pattern is producing too many defective castings the subcontractor is in position to stay close to the work until the cause of the trouble is located and remedied.

Not only is immediate supervision kept over the molding operations, but the mixtures and melting operations are closely controlled. The laboratory has complete control of the mixtures and melting operations. A laboratory representative supervises the weighing of the metal and coke for the cupolas, and as the laboratory makes all the tests it is held responsible for the quality of the metal which goes into the iron. Not only is it necessary to produce iron which will make good castings, but the correct metal must be poured into molds to meet the requirements of the railroad to which the castings are to be sent. As the specifications from the different railroads vary more or less, care must be exercised to make sure the right metal gets to the mold.

FIG. 4—SHAKING-OUT GRID OF THE SAND CONDITIONER

To secure control of the iron every car of pig iron received is analyzed. When possible, the iron is used as it is received, being transferred directly to the charging platform from the railroad car. In case several cars are received at one time, and the metal cannot be used in the cupola immediately, it is unloaded on a pile according to its silicon content, no attempt being made to keep each car separate. Two grades of iron, according to silicon content, are purchased. The one grade, used for cylinder and similar castings, ranges from 1.15 to 1.50 per cent silicon, while the other grade, used for what the foundry terms floor iron, has a silicon range of from 2.30 to 3.00 per cent. In both grades the sulphur is required to be less than 0.05 per cent; the phosphorus between 0.50 and 0.80 per cent, and the manganese between 0.50 and 1.00 per cent. Selected steel scrap and cast iron scrap are mixed with the pig iron to give the desired percentages in the metal.

FIG. 5—FILLING END OF THE SAND CONDITIONER

With the analysis of each carload of iron known, iron can be made with a silicon range of from 0.75 to 2.40 per cent, by mixing the proper pig iron with cast iron and steel scrap. Iron below 1 per cent silicon is poured into accumulator rams, piercing dies and heavy die blocks, while for cylinders and medium weight castings the silicon ranges from 1.0 to 1.50 per cent. The smaller castings with light sections have more than 2.0 per cent silicon.

Control of the iron also is obtained by chill tests which are cast before the iron is poured into the mold. These tests can be quenched in water in a few minutes after they are cast without affecting the chill or the grain of the metal. Then by breaking the test piece and examining the chill it is possible to determine whether the iron is as it should be for the particular casting or castings for which it is destined.

A chill mold capable of holding 15 to 20 test specimens is placed beside each cupola. The test piece is 1¼ x 2 x 12 inches long, and enough draft is given to allow the pieces to be withdrawn easily from the mold. A test is taken from the iron for each cylinder and to rep-

resent the iron in each casting where more than one ladle is used. For the smaller castings the chill test is taken from each ladle. The inspector soon becomes familiar with the appearance of the fracture so he can determine from it whether the iron is suitable for the purpose for which it is intended. It might be argued that with the analysis of the iron there should be no need for chill test specimens, but the requirements are so close that the metal may have the correct amount of silicon and still be unsuited for the purpose owing to the amount of carbon or sulphur picked up in melting, or to the pouring temperature. For locomotive cylinders the iron in the test specimen should show on the bottom a white chill for a depth of from ¼ to ½ inch, and for accumulator rams and piercing dies from ¾ to 1¼ inches deep. However, when a chill shows on the test specimen representing iron for the smaller castings the castings are likely to be hard.

In addition to the chill test specimens, bars are cast to the dimensions of the arbitration bar of the American Society for Testing Materials for transverse and tensile test. These bars also are used for analytical samples. The laboratory is equipped fully for both physical and chemical tests and each laboratory man is trained to make all routine tests.

A uniquie feature of the foundry building is that it is divided into seven bays running longitudinally through the building, with the stock bay in the center, and the cleaning room and repair departments located in four bays at the end running across the building. With the stock bay in the center the cupolas are advantageously located to deliver iron to the different molding floors, as may be seen in Fig. 6. That this is essential will be recognized when it is realized that the building is 1150 feet long by 358 feet wide all under one roof. The cross bays take up 250 feet of the length of the building leaving the longitudinal bays of the shop 900 feet long.

Pig iron, coke, firebrick, limestone, sand and other supplies are brought into the shop on a track extending along the center of the stock bay for its entire length. Sand and limestone are unloaded by the crane, using grab buckets, while pig iron is carried from the cars to the stock piles by magnets. When it is desired to carry the pig iron directly from the cars to the charging platform it is loaded by hand on buggies placed in the railway car as indicated in Fig. 2. One of these buggies being carried to the cupola charging platform by the crane is shown in Fig. 3, which also shows some of the pig iron and scrap stock piles. The charging platform extends for a short distance into the stock bay to allow the crane to set down the buggy. In some cases the charge is made up on the charging platform, while in others the charge is weighed before it is taken to the charging platform. Coke is shoveled from the cars to prevent breaking and is carried to the charging platforms in racks handled by a crane.

One 20-ton and two 10-ton cranes serve the stock bay on which the charging platforms of the nine cupolas are faced. All of the cupolas are hand charged except the two which furnish the iron for the large miscellaneous castings. These are equipped with charging devices, tracks, and side-dump cars furnished by the Whiting Corp., Harvey, Ill. To prevent the charge from breaking the lining of the cupola as it is dumped in, the upper rows of lining for the machine charged cupolas are formed of T-shaped gray iron castings. The top of the T is curved to correspond to the contour of the inside diameter of the cupola, and the flanges on each side allow the sections to be bolted together. The base of the T is provided with a foot which rests against the shell of the cupola. These cast ings have a long life and materially reduce the expense of upkeep of the cupola lining.

The two larger cupolas are equipped with forehearths for collecting the molten iron, as shown in Fig. 1. This shows the cupola at the right in operation while the other is being cleaned preparatory to a run on the following day. The fan shown at the right furnishes air for the cupola next to it. Every cupola in the foundry is similarly equipped with an individual fan. Slag from the cupolas is caught in dump buggies to be wheeled away instead of being allowed to drop on the ground.

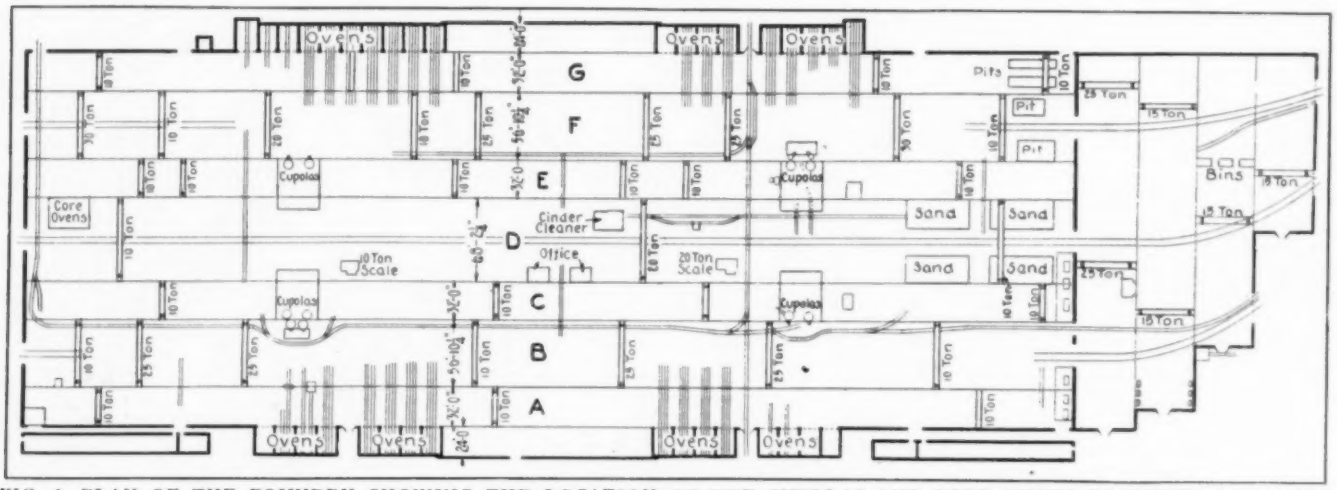


FIG. 6—PLAN OF THE FOUNDRY SHOWING THE LOCATION OF THE CUPOLAS AND CORE OVENS TOGETHER WITH THE CRANES—NOTE THE STOCK BAY IN THE CENTER

The company operates one cupola of the vallieau type for special mixtures. This cupola, which is a French product, is equipped with a hollow iron lining at some distance above the melting zone, for the purpose of preheating the air which is passed through it. This is a simple, sturdy type so constructed as to give any temperature of blast from 200 to 1000 degrees Fahr. The extra heat is sometimes necessary in emergency work.

As may be noted from Fig. 6, the core ovens are on both sides of the foundry, the cores being made in these sections and sent to the molds in the adjoining sections. The metal then is brought to the molding floors from the cupolas which face into the floor from the opposite direction. In the bay marked *A*, which is 32 feet wide, the cores are made for the medium sized locomotive castings, such as steam pipes, power reverse cylinders,

superheaters, etc. The sand for the gravel cores is stored in a bin between the ovens and is mixed in a mill of the muller type. The sand for the oil-sand cores is screened through an electric vibrating screen after it is mixed. The preparation of the sand is under the direction of one man who is held responsible for its uniformity. Sand from the mills is delivered in drop-bottom boxes to the coremakers' benches by cranes of which this bay is equipped with three of the bridge type and 10-ton capacity.

FIG. 7—HIGH MOLDS ARE PLACED IN PITS AND ARE DRIED

Sixteen core ovens, arranged to be heated with either oil or coal, face on this bay as indicated in Fig. 6. Each oven is 17 feet wide, 10 feet high, and 22 feet deep. Double tracks on which the core trucks operate extend into the oven and out into the bay. The trucks are pulled in and out of the ovens by the cranes, using wire ropes which extend through pulley blocks fastened to the floor. These ovens, like all the others in the shop are equipped with recording pyrometers. Usually the cores are baked at a temperature of 450 or 500 degrees Fahr., but on occasions when the cores have been wanted in a rush, as high as 900 degrees has been used without appreciable detriment to the core. The cores are handled on and off of the oven car by the cranes as indicated in Fig. 8.

The medium size locomotive castings weighing between 100 and 3000 pounds are made in the bay marked *B*. One end of this bay is used for making large castings with comparatively light sections, such as steam pipes, sand boxes and smokestacks while driving boxes, bumpers, cylinder heads and similar castings with heavy sections are cast in the opposite end of the bay. Six jarring machines are arranged at advantageous points to serve the different floors in this bay. The molds and iron are handled by four 25-ton and three 10-ton traveling cranes. The majority of the molds in this department are made in green sand. The facing sand all is mixed in equipment located near one end of the section. Fig. 4 shows the shaking out-grid of the sand conditioner, and Fig. 5 shows the delivery end. The sand is brought to the conditioner and carried to the molding floors in drop-bottom boxes. One of the sand bins which extends to the stock bay may be seen at the left, Fig. 4. Sand is loaded into these bins by one of the cranes which serve the center bay, using a grab bucket. Four cupolas deliver iron to this bay. The iron is carried by a crane, except when it is necessary to deliver it to one of the other bays when it is hauled on a car by a narrow gage locomotive, as shown in Fig. 9.

FIG. 8—LOADING CORES ON THE OVEN CAR WITH A CRANE

A narrow bay, 32 feet wide, separates the bay marked *B* from the center bay. In this bay, which is marked *C*, the light snap flask work is carried on. Nine machines and several benches are provided. Four 10-ton cranes serve this bay, handling 3000-pound ladles of iron which is transferred to hand ladles for pouring the smaller castings.

On the opposite side of the stock the foundry is divided into three bays of dimensions corresponding to the three bays described. Large cylinder cores are made in one end of the 32-foot bay next to the stock bay. In the other end molds are made for castings of medium size. One tilting and one revolving brass furnace are located near the center of the bay. These furnaces serve a floor where the faces and sides of driving boxes are lined. Six 10-ton traveling cranes cover this bay. The locomotive cylinders and large miscellaneous castings are made in the 56-foot bay marked *F*. The 48 iron pits for molding the cylinders described in the previous article of this series, are located at one end of this bay. These pits are arranged in two groups extending across the bay in two rows of four abreast. Two large jarring machines are used for ramming the cylinder cope and the cylinder pit patterns mentioned.

Another jarring machine is used at the other end of the bay for jarring miscellaneous medium size castings and large cores. Three pits of concrete lined with steel plate are provided at this end of the bay for casting accumulator rams and other large castings where the sections of the mold are taken apart for drying and reassembled. These pits are 20 feet long by 12 feet wide and vary in depth from 8 to 20 feet. One of the pits is shown in Fig. 7. As nearly all the molds in this section are made of dry sand, a large complement of cranes is required for the extra handling for getting the molds in and out of the ovens. The bay is served by two 30-ton, three 25-ton, one 20-ton and three 10-ton cranes. Four muller type ma-

chines prepare the sand. Iron is supplied by the four cupolas which face on this bay.

Cores for the cylinders and large miscellaneous castings are made in the last bay on this side *G*, which like the corresponding bay on the opposite side of the shop is 32 feet wide. Nineteen core ovens similar to the ones in bay *A*, serve this bay. The sand which is stored in a bin capable of holding 1000 tons of sand and covered with sectional roofing is mixed in a muller type machine and delivered to the coremakers.

Castings when taken from the sand

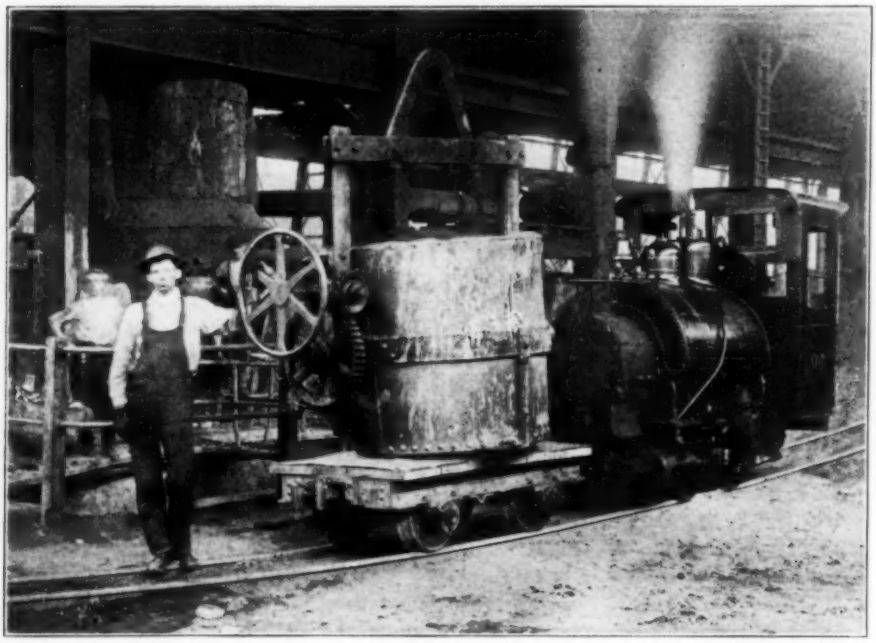


FIG. 9—A LOCOMOTIVE CONVEYS METAL FROM ONE BAY TO THE OTHER

are delivered to the cleaning department, in bays *H* and *I*, extending across the shop at the end of the molding bays. Cranes load the castings on cars which travel on the narrow gage tracks that interlace the shop, and a locomotive, one of which is shown in Fig. 9, draws the cars to the cleaning department. Six large dust collectors are installed in the partition which separates the cleaning department from the foundry proper. An air line with hose connections is located at every column in the cleaning department. Air is carried at 80 pounds pressure for use in cleaning and chipping castings. The cylinder and the other large castings are cleaned in bay *H*, while the smaller castings are cleaned in bay *I*. The more intricate of the smaller castings are cleaned in a sand-blast barrel and the more rugged of the smaller castings are cleaned in seven tumbling barrels.

Bay *J* is a repair shop, equipped with one 15-ton crane and the lathes, shapers, drill presses and grinding wheels required for assembling the flasks, repairing the ladles and taking care of the foundry equipment. The end bay, equipped with a 15-ton crane is the shipping department.

Purchases Interest in Engineering Company

Effective Dec. 29, Milton W. Arrowood announces that he has purchased all the interest held in his company by the Sanford Riley Stoker Co. since Dec. 22, 1922. The business known during the past year as the Ground Coal Engineering Corp. will now be operated by Mr. Arrowood and his associates in Chicago, who have been connected with the company since its organization in 1917, at which time the original partnership was founded and, until incorporation in 1922 was known as the Ground Coal Engineering Co. The corporate name has been changed to Universal Engineers, Inc. The company engages in pulverized fuel work, in addition to a general line of activities in conveying and handling material. The success of its method in handling pulverized fuel has led to expansion in other fields. Pending the establishment of offices in New York and Chicago, all correspondence should be addressed to the company under its new name at 2 Downing street, Worcester, Mass.

The Detroit Testing Laboratory is constructing 3-story building at 554 Bagley Ave., Detroit, which will be ready for occupancy about April 1.

Book Review

American Society for Testing Materials Tentative Standards, 1923, 859 pages, paper or cloth, 6 x 9; published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland; price $7.00 in paper and $8.00 in cloth binding.

Tentative standards are those specifications and methods which are published by the society for at least a year before their adoption as standard with a view of obtaining criticism of which the respective committees take cognisance before recommending the specifications for final adoption as standard. The present volume contains 170 such tentative standards many of which are of vital interest to the foundryman. Of the 23 tentative standards relating to ferrous metals, and the 12 relating to nonferrous metals, the foundryman is particularly interested in those for steel castings, for carbon-steel castings for railroads, for electric cast-steel anchor chain, for foundry pig iron, for chilled cast-iron wheels, and for high-test gray-iron castings, besides several tentative standards for babbitt metal, aluminum ingots, etc. Methods of heat treating carbon-steel castings are outlined and methods given for the analysis of carbon steel, alloy steel and pig lead. Among the other classifications which have an interest for the foundryman are specifications for coal and coke, and petroleum products and lubricants.

Advertising Manager Is Appointed

Peirce Lewis has been appointed advertising and sales promotion manager of the Truscon Steel Co. and will have complete charge of this department now located at the home office and plant in Youngstown, O. Mr. Lewis has had a wide experience in advertising and sales work, having been connected with Kewanee Mfg. Co., Kewanee, Ill., the Detroit Steel Products Co., Detroit, and as assistant advertising manager of the Truscon Steel Co.

Opens Southern Office

The Pawling & Harnischfeger Co. of Milwaukee, manufactuer of excavators, cranes and machine tools, recently opened new offices in the south. N. B. Norris, formerly district manager at New Orleans, now is district manager of the Memphis office. D. J. Murphy, formerly at the New Orleans office, now is district manager of the Texas district with headquarters at Dallas. W. J. Dugan, as southern sales manager, will take charge of all the southern territory with offices at Memphis.

Discuss Steel Foundry Work

British Practice Is Described and the Common Problems Are Stated—Annealing of All Castings Which Must Stand Shock Is Urged —Sand Reclaimed by Renovation Process

BY F. A. MELMOTH

THE question of fluidity is one of very great importance to the manufacturer of light steel castings, and during the past year or so much discussion has taken place regarding the relative fluidity of electrically produced, and converter steels. If converter steels are compared in terms of fluidity with the ultradead electric steel, produced under a highly basic, strongly reducing slag, the author is definitely of the opinion that the converter steel is the more fluid. This has been stated to be due to various causes, the most usual one being the assumed presence of oxides. It has been stated that the longer *life* of converter steel is due to incomplete reactions between the finishing alloys and dissolved oxides, these reactions continuing with the production of heat during the casting of the metal. The author would only say that he has never been able to find differences of analysis at the beginning and ending of a cast of con-

Paper presented at the annual meeting of the Institution of British Foundrymen, held in Manchester, England, recently. The author, F. A. Melmoth, is engineer for the Braintree Castings Co., a subsidiary of Lake & Elliot, Ltd., Braintree, England.

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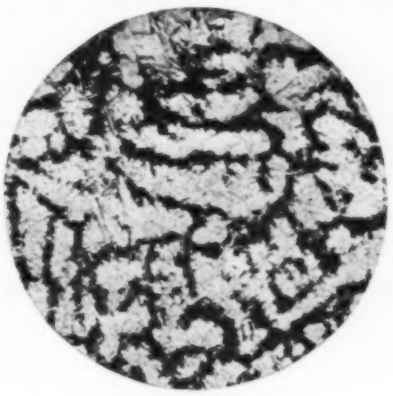

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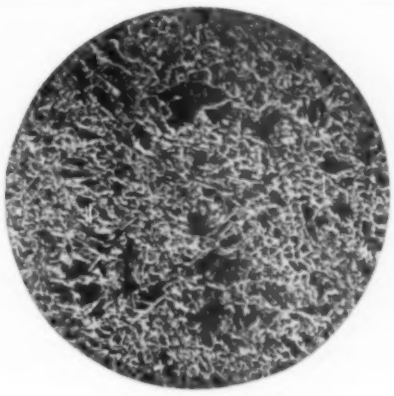

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Table I

Analyses and Physical Tests of Cast Steel

		Carbon per cent	Silicon per cent	Manganese per cent	Sulphur per cent	Phosphorus per cent
Series B		0.23	0.31	0.82	0.008	0.032
Series C		0.30	0.38	0.75	0.010	0.026

Mark	Heat treatment	Ultimate strength lbs. per sq. in.	Yield point lbs. per sq. in.	Elongation, per cent on 2 in.	Red. of area per cent	Bending angle 1 x ¾ in.	Brinell number	Izod impact foot-lbs.
B1	Nil	76,115	Not discerned	17.0	17.8	57 degrees—cracked	170	1.0
B2	900 degrees Cent. cooled slowly	72,775	40,900	36.0	53.0	120 degrees—unbroken	156	24.0
B3	Quenched in water from 900 degrees Cent. tempered 45 min. at 550 degrees Cent.	89,445	61,420	23.0	38.7	76 degrees—cracked	196	31.5
C1	Nil	92,020	Not discerned	9.0	9.5	19 degrees—broken	217	almost nil
C2	900 degrees Cent. cooled slowly	85,500	49,080	28.0	37.2	120 degrees—unbroken	187	16.0
C3	Quenched in water from 900 degrees Cent. tempered 45 min. at 550 degrees Cent.	105,390	70,000	16.0	22.2	48 degrees—broken	228	17.0

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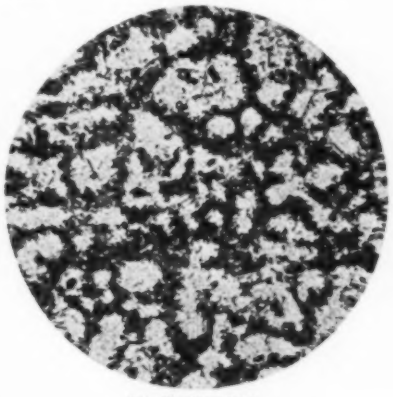

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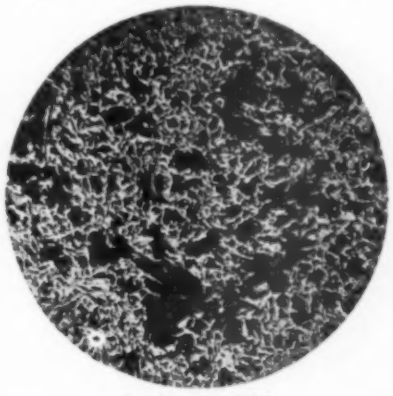


C3 X 100 DIA.

verter steel, properly made, of an amplitude sufficient to suggest that any appreciable amounts of silicon and manganese were oxidized and passed to the slag during casting. This, in spite of the fact that on small castings, it may take nearly 30 minutes to dispose of 3000 pounds of metal.

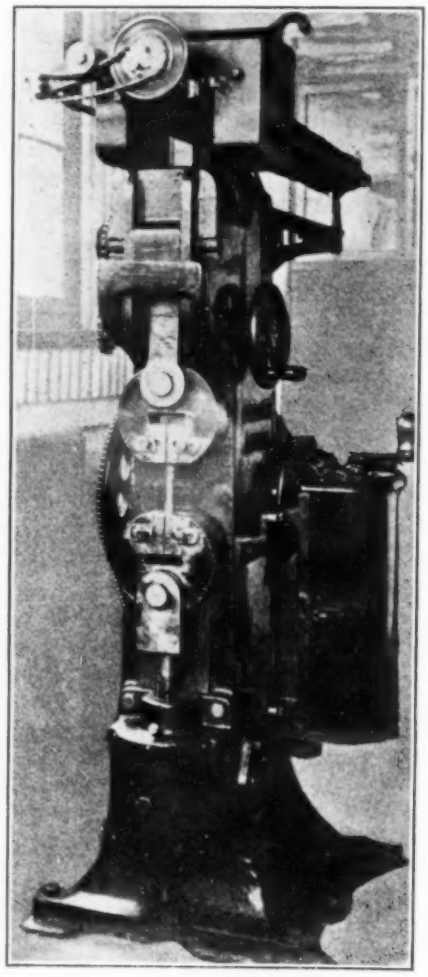
In contradistinction the author believes that W. H. Hatfield has stated in discussion that in properly made steel no free oxide can exist. It is assumed, therefore, given constant composition in the orthodox steelmaking sense that fluidity is merely a function of temperature. In the author's own experience in the production of soft steels for light castings a marked difference does not only exist between the converter and electric steels made under a strongly reducing slag, but also between what are known as single slag and double slag electric furnace charges. As is well known single slag charges are never subjected to such a highly reducing slag action as are those in which the first slag is removed, and a new one made for finishing purposes where refining is requisite. The author has seen many charges, subjected to refining slags for a longer period than normal, which have been so hot that the furnace has been badly damaged, and the stopper in the ladle quite unable to withstand the temperature, and yet when hand shanked have not *lived* by any means so long as a single slagged charge made in a normal manner and of average apparent temperature.

Only a reliable means of regularly ascertaining the temperatures of molten steel not on a single charge, but over a prolonged period, together with the evolution of a really reliable method of estimating oxygen, or rather the oxides, in steel, can throw any true light on the problem. In its present state, the matter stops at assumption based on observed phenomena.

Effects of Metalloids

The influence of sulphur and phosphorus has, in the author's opinion, been somewhat exaggerated from the standpoint of their effect in causing defects in steel castings, many cases having come to his notice where these impurities have been blamed for cracks in castings, which on consideration could be definitely assigned to neglect during molding to provide means of easy contraction of the casting while cooling. There is no doubt that an excess of sulphur is liable to make mild steels, cast into sand molds, less able to resist the stresses to which castings are subjected during solidification and after cooling.

However, in the author's experience large numbers of intricate castings made from steel containing 0.06 to 0.08 per cent sulphur, have given not the slightest difficulty in this direction, assuming design to be reasonable, and the necessary care taken during molding and coremaking. The effect of phosphorus in excessive quantities is more liable to be shown while the casting is in service, its tendency being to reduce the resistance of a casting to repeated shocks. This appears to be the case regardless of the fact that such steels, say containing 0.01 per cent or more of phosphorus, show no signs of inferiority under the ordinary tests to which castings are subjected, the tensile and elongation capabilities of the metal being almost, if not quite, as good as in the case of steels containing mere traces of phosphorus. However, given an upper limit of 0.06 per cent no trouble need be anticipated.



TENSILE TESTING MACHINE

Their freedom from sulphur and phosphorus has often been advanced as the reason for electric steels giving a higher standard of performance under test, than the average converter steel of similar composition. It is the author's opinion that more probably the reason is the freedom of the electric steel from nonmetallic inclusions, and its susceptibility to heat treatment. The *as-cast* structure of an electric steel has always appeared to the author to be more easily removed by heat treatment than that of converter steel of similar analysis.

The use of aluminum in reasonable quantities is beneficial, and indeed essential to the production of steel castings. However, any large excess is highly deleterious. In an experiment carried out by the author comparisons of results, obtained on test bars attached to steel castings dosed with varying quantities of aluminum, showed that excessive amounts lowered maximum stress, yield point and elongation and decidedly reduced the capacity of the material to resist shock.

Low carbon ferrotitanium has been used as a final deoxidizer, the result found being a small but regular increase in the tensile strength. However, with electrically produced steels, this material is not a necessity.

The vast majority of steel castings of the type herein dealt with is produced by machines. Under the present conditions of low prices and severe competition for every order available, it is no longer possible to produce such molds economically by hand, except in certain highly specialized cases. Where of special intricacy or in cases where difficulties of design or a multiplicity of loose pieces make machine molding inadvisable, it is the practice in the author's works to use match plates.

The material of which the match plate is made naturally depends upon the number of molds to be produced from it, and in these works plaster or wood is generally used. For many small parts, particularly the smaller types of chassis castings, in which design, from the point of view of rapid production, is not always all it might be, this has been found to be quite an economical method.

Patterns on Metal Plates

Whenever possible, however, patterns are mounted on metal plates or boards for production on some type of molding machine. The squeezer, jolt-ram pin-lift, jolt-ram rollover types of machines are in constant use for such work, but the author's preference for small work is for the jolt-ram pin-lift type.

For a larger class of casting, probably involving more intricacy, and a greater depth of draw, the best re-

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections 5 x 7 inches, and may be readily bound in note book form.

SPECIFICATIONS FOR WELDING ELECTRODES

Recommended Sizes

E-No. 1A and E-No. 1B..... 1/16, 3/32, 1/8, 5/32, 3/16, 1/4 inch diameter
E-No. 1C .....1/8, 5/32, 3/16, 7/32, 1/4, 5/32, 3/8 inch diameter

Uses

E-No. 1A and E. No. 1B—For welding mild steel, structural shapes, plates, bars or low carbon steel forgings and castings.

E-No. 1C—For welding high carbon steel and worn surfaces where great resistance to abrasive wear is desired and where machining is not necessary, such as rails, frogs, switch points, bearing surfaces, etc.

Surface Finish

The surface shall be smooth and free from rust, oil or grease.

Tests

In the hands of an experienced welder electrodes shall demonstrate good weldability in *flat* and *overhead* positions and shall pass through the arc smoothly and evenly without any unusual characteristics.

Packing

Electrodes shall be delivered in coils or in straight 14-inch lengths, packed and wrapped as follows:

(a) Bundles of 50 pounds net weight, securely wired and wrapped in heavy weatherproof paper.

(b) Bundles of 50 pounds net weight, securely wrapped in heavy burlap.

(c) Boxes or kegs of 100, 200 or 300 pounds net weight, and wrapped as per paragraph (a).

(d) Boxes or kegs of 100, 200 or 300 pounds net weight, and wrapped as per paragraph (b).

(*Concluded on Data Sheet No.* 514)

SPECIFICATIONS FOR WELDING ELECTRODES

(*Concluded from Data Sheet No.* 513)

(e) Coils of approximately 50 or 100 pounds net weight, and wrapped as noted in paragraph (a) or (b).

Marking

All bundles, coils, boxes or kegs shall be provided with a metal, linen or strong fiber tag securely wired to or in the case of boxes or kegs, nailed on the outside, bearing the following information:

Make .....
Specification No. .....
Diameter .....
Nominal Weight .....

Ordering

Material ordered under these specifications shall be known as:

Electrodes, iron and steel, bare, American Welding Society Specifications No. 1, Revised May 1, 1921.

All orders should be specified in pounds. In addition, requisitions shall show the following:

Specific. No.
Size
Packing

As a guide in ordering, the following information is of use:

Size, inches	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/32	3/8
Lb. per 100 ft.	1.04	2.3	4.1	6.5	9.3	12.76	16.7	21.0	26.0
Ft. per 100 lb.	9615	4273	2403	1537	1067	700	600	473	383
Mils	63	94	125	156	188	218	250	281	312

BLYSTONE MANUFACTURING CO.

BLYSTONE
Batch Mixers for Mixing
Wet or Semi-Dry Concrete,
Plaster, Mortar,
Coloring Materials, Core Sand

BLYSTONE
Dry Wall Tile Machines
Lift Trucks, Stacking Racks
Cars and Accessories
General Product Plant Equipment

LUTHER G. CONROE
GENERAL MANAGER

CAMBRIDGE SPRINGS, PA.

May 31, 1923

The Foundry
Penton Building
Cleveland, Ohio.

Gentlemen:

Attention: Mr. Pease

You will probably be interested in the fact that for the past ten years the Blystone Manufacturing Company has kept a record of the sales made from inquiries received from advertisements of the Blystone Mixer in the Foundry. More than eighty percent of these inquiries have resulted in orders for Mixers.

Your untiring efforts in preparing advertising matter and the exceptional service given us have been appreciated.

One ad which your department furnished us, consisting of the old man bowling, has been used several times in the Foundry. While our customers and the Blystone Manufacturing Company have worn out two electros in making leaflets to circularize the trade, never have we used an advertisement which has called as much attention as that furnished by you.

Thanking you for the many courtesies extended us, we remain

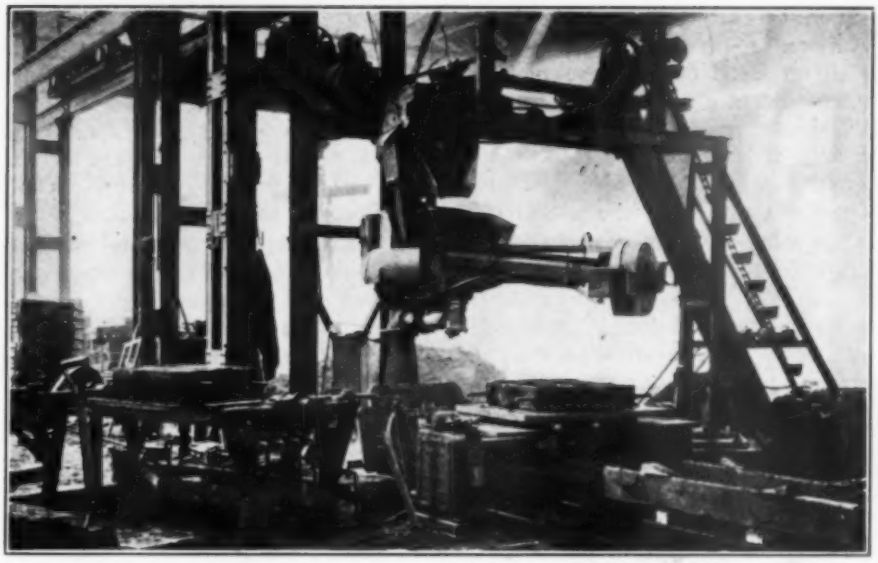
Yours very truly,
BLYSTONE MANUFACTURING COMPANY

Luther G. Conroe
General Manager.

LGC/MM

sults have been obtained from jolt-ram rollover machines with pattern drawing attachments. Unskilled labor can be trained quickly to handle these machines, and when properly equipped with good flasks and well-made patterns, preferably of metal, the output of molds is large. At the same time the casting produced is almost always of better finish, and more true to pattern than is the case when hand molded.

The main point to be considered in machine molding is the adequate supply of satisfactory equipment. First-class flasks machined on the joint and bushed with hard bushings, case-hardened locating pins on the pattern plate, and case-hardened closing pins have been found along with well-finished metal patterns, to be essentials, if the full benefits of machine production are to be attained.



THE SAND THROWING TYPE OF MOLDING MACHINE IS USED FOR HEAVY WORK SUCH AS THAT SHOWN

The majority of the castings dealt with in this paper are cast in green sand molds, and owing to the unavoidable presence of considerable amounts of moisture, the question of permeability of the sand is of prime importance. The best results have been obtained in the works with which the author is connected from a coarse grade of silica sand, thoroughly milled with a sufficient quantity of sandy loam to give the necessary plasticity. The minimum amount of water should be used, and the amount of bond should be just sufficient to enable a quantity squeezed in the hand to retain its shape, and no more. A mixture so made, and efficiently rammed, is found to possess the necessary resistance to the stream of metal, whilst possessing adequate permeability to vapour and gases. If too wet, it will be almost certain to ram too hard and close, and become a fruitful source of porous castings.

To obtain the best results, particularly in small intricate castings, it was at one time considered necessary to use new sand entirely for facing.

Table II

Sieve Tests of Renovated Sand

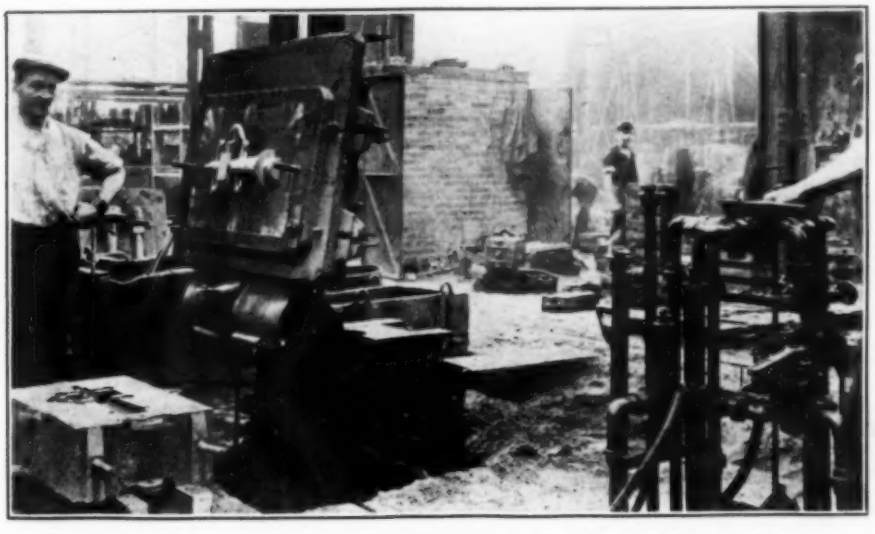
Sample taken from renovating plant	Meshes to the inch: 120	100	80	60	50	40	30	30
	Per Cent Through							
10 a. m.	3.86	2.27	0.56	10.45	3.63	25.9	30.68	22.65
12 a. m.	1.36	1.13	0.68	9.09	2.72	20.22	30.0	34.80
2:20 p. m.	1.60	1.60	0.68	8.23	3.86	20.68	32.5	30.85
3:30 p. m.	2.27	1.60	1.13	6.82	3.64	22.95	31.36	30.23
4:30 p. m.	1.36	1.60	0.91	8.00	4.54	23.17	31.13	29.29
(1)	8.6	4.9	5.2	7.4	6.5	24.7	21.8	20.9
(2)	1.13	0.23	trace	1.13	0.91	16.59	43.41	36.6

(1) Average floor sand, before renovation.
(2) Average new silica sand for comparison.

Fineness Increases

Some time ago the author carried out a prolonged series of experiments with a view to determining the reasons for the unsatisfactory results obtained from facing sands for such work when old sand was used. It was found that the sand on being used repeatedly contained increasing quantities of fine silt, originating, of course, in the clay used as a bond which silt was very high in alumina. The action being accumulative, the ultimate effect was the almost complete suppression of the permeability of the sand, with obviously fatal results. The removal of this silt in all cases left a sand which, when mixed with the requisite bonding material, gave results in every way equal to new sand. By means of a patented apparatus, the dust is now removed by a current of air, and in these works quite a large proportion of used sand is included in all sand mixtures.

The accumulative increase of fine dust in the backing sands, where large quantities of green sand castings are made, has, in the author's experience been found to be the cause of many cases of mysterious unsoundness. Often, although great precautions are taken where facing sand is concerned, the backing sand is somewhat ignored,



MANY TYPES OF MOLDING MACHINES ARE USED IN BRITISH STEEL FOUNDRIES

until it is sharply brought to notice by a series of porous castings, for which no metal or excessive moisture explanations are forthcoming. In my opinion, for mild steel castings, particularly of a small nature, the backing sand should be subjected to just as severe a scrutiny and constant testing as the facing sands.

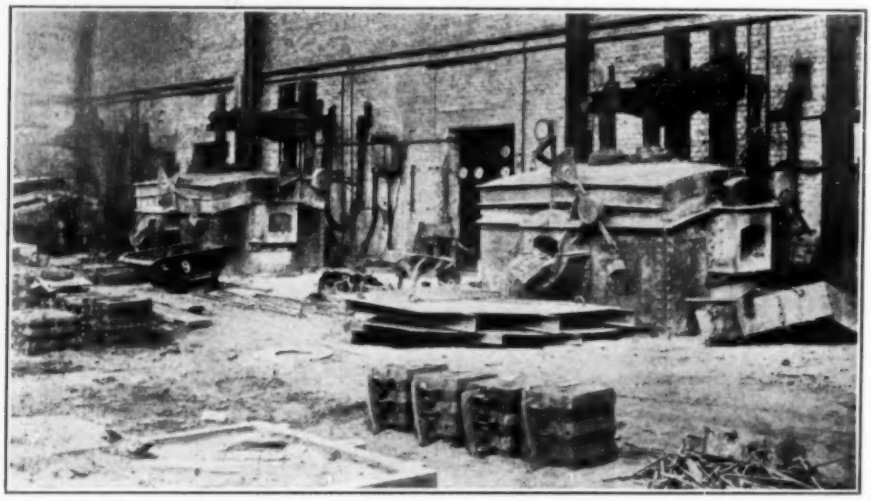
Table II shows average samples of sands before and after undergoing the aforementioned renovating treatment. The dangerous portions can be taken to be those passing through sieves of 80 meshes to the inch and finer, and in these terms a comparison is as follows:

	Per Cent
New silver sand.....	1.36
Untreated floor sand.....	18.7
Average of six renovated samples	7.20

The renovating process has, therefore, removed dust and fine particles to the extent of 11.5 per cent of the total weight of the floor sand treated. It should be noted that all sands were thoroughly dried before passing to the renovating plant.

Opinions as to the advisability of using chills on steel castings vary considerably, but it has been the author's experience that when they are judiciously used and due care is taken to see that they are perfectly clean, considerable benefits can be derived by their use in certain types of casting. wing to the high contraction of mild steel, sharp differences of section are liable to produce difficulty, due to unequal rates of cooling in the mold, and it is common experience to find that the thicker portions, owing to indiscriminate design, are in such positions as to preclude the possibility of feeding heads being attached. In such cases a properly designed chill offers a way out of the difficulty, and although the author realizes that when the chills are carelessly used, pulls, and very often unsoundness, results, he has experienced many cases of special design where the use of external, or sometimes internal, chills have proved the only solution.

It often appears that the cleaning department receives but scanty attention, and in some cases this department has represented a veritable bottle neck, becoming a brake of serious import on otherwise well designed foundry production schemes.



MANY BRITISH FOUNDRIES ARE EQUIPPED WITH ONE OR MORE ELECTRIC FURNACES

It is essential that this department be adequately equipped to handle quickly and economically the full output of the foundry.

Unfortunate as it is to have to make the admission, a welding plant is an essential requisite. Properly used, and under judicious control, such a plant is capable of considerably reducing the proportion of defective castings. While looking upon it as a necessary evil, for the repair of essentially surface and unimportant defects it should be realized that a weld made correctly possesses almost the strength of the metal of the casting. Also a surface repair by welding if correctly done gives satisfaction.

Annealing Is Requisite

In the case of small castings, it was at one time considered possible to dispense with annealing or any form of heat treatment, when the steel used was of a dead soft composition.

The micrographs and tests shown in Table I indicate this to be incorrect. Except in the rare cases where a casting in service is never subjected to repeated or alternating shocks or to any form of impact shock, heat treatment is an essential. It is also a fact that should a small flaw exist in a casting it will, under service conditions, travel at a much greater speed through the casting and cause fracture if the casting has not been suitably heat treated. There is also the important point to consider that in castings of any degree of intricacy, heavy stresses, due to irregular section, occur in the cooling from the liquid condition in the mold. These stresses remain locked up in the casting and liable on shock or undue stress to release themselves by fracture. They are to a great extent removed by the reheating of the casting to a suitable temperature followed by a comparatively slow and even cooling.

Removing Internal Stresses

While this removal of internal stresses is of importance, the fundamental of heat treatment is the recrystallization of the material, the coarse, angular crystallinity being replaced by a fine, close structure entirely free from the strong cleavages and consequent susceptibility to shock fracture of the as-cast condition. In the case of the mild steels commonly used in the production of such castings this is achieved by heating to a temperature above the upper recalescence point of the steel, say 880 to 900 degrees Cent., holding at this temperature for a sufficient period to ensure the complete solid solution of the coarse ferrite arrangement, and afterwards cooling evenly and slowly. The time obviously depends upon the mass involved, the period being increased with the weight of the casting treated, and the thickness of its section. This treatment is preferably carried out under accurate pyrometric control. The examples given in Table I were treated, not in a laboratory, but in the shop under ordinary commercial conditions, in furnaces fired with producer gas and controlled by thermo-electric pyrometer. The results given are all of electrically produced basic steels.

As previously mentioned the author believes such steel to respond much more quickly to equivalent heat treatment than converter steels. This may be due to a liability on the part of the latter material to recrystallize during cooling from the heat treatment temperature along the lines of the pre-existing as-cast structure, probably owing to the presence of non-metallic inclusions, which retaining their as-cast form during treatment, afterwards act as nuclei for the precipitation or formation of the ferrite on cooling. Where castings are called upon to perform specially high duty,

it has been found that good results can be obtained by quenching, either in oil or water, and afterwards subjecting them to a low temperature tempering treatment. The results of such treatment are shown in Table I.

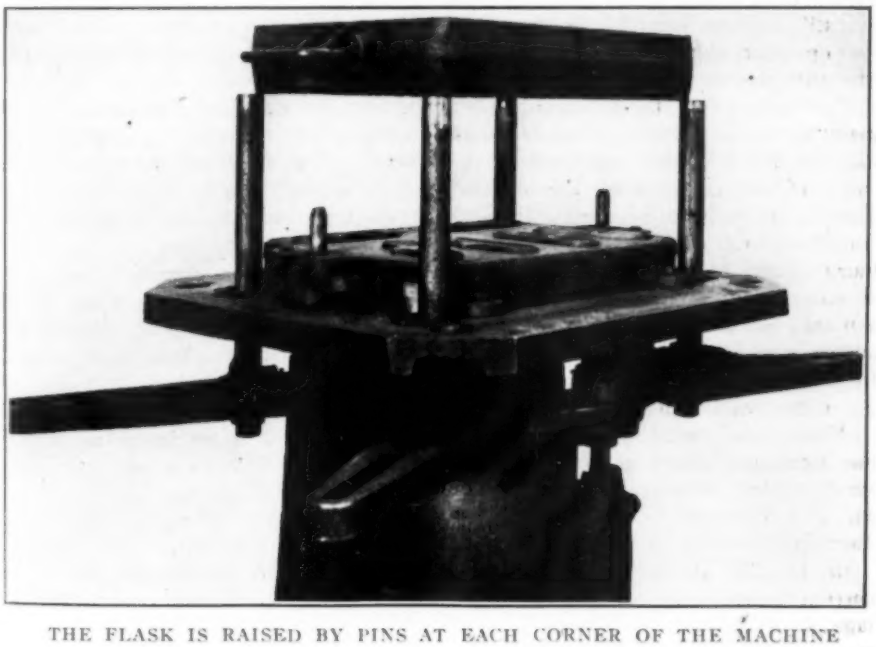
Blowholes are among the more prominently occurring defects in steel castings. This defect may be due to a variety of initial causes, several being connected directly with the metal used, and others being due to the influence on the metal, during casting, of factors introduced in the making of the mold or cores.

Active Oxides the Cause

From the metal standpoint the presence of blowholes is due to the metal being cast in such a condition as to contain active oxides which, reacting with the carbon present, produce a gas which is evolved during solidification. Or again, the metal may contain other dissolved gases which are evolved from solution as the material crystallizes from the fluid condition. In the great bulk of such cases the analysis of the steel for the common steelmaking constituents will almost always lead to a defect in the melting practice, which is comparatively easy to correct. However, blowholes, in cases where metal analysis is satisfactory, cannot always be so definitely assigned to a single cause. Excessive quantities of moisture, lack of efficient venting of the mold or core, the use of too fine a sand either as facing or backing, the closing of a partially dried mold while warm, with the consequent formation of steam in the mold, and the use of chills, internal or external, in an unfit condition, are all well known causes. Therefore, it is only by a process of elimination applied to one after the other of the possible causes, that the real reason for a case of such unsoundness can be definitely ascertained and a remedy applied.

Blowholes in castings occur in two distinct forms, one in which they are scattered more or less evenly as small holes throughout the entire casting, and one in which they exist as larger cavities, usually to be found in or near thicker portions or in a radius. In the first form it is probable that the metal is at fault, but as excessive moisture in the sand causes defects similar in appearance, judgment on the matter cannot be too impetuous. In the second form described the holes are often described as *draws* and the metal possesses excessive liquid contraction which has caused holes to occur where normally such action does not occur. However, in many intricate types of casting the author has noticed that this second type of defect occurs oftener with a low casting temperature, than when the steel is hot and fluid. Therefore, he assumes that frequently cavities described as *draws* are in reality *blows* and are due to the period during which the steel is liquid in the mold, being too short to allow of the escape of certain gases blowing into the metal usually from projections in the mold or cores.

CASTINGS OF INTRICATE DESIGN REQUIRE GREAT CARE IN THEIR PRODUCTION



THE FLASK IS RAISED BY PINS AT EACH CORNER OF THE MACHINE

Contraction cracks may be due either to a metal so impure as to be excessively weak immediately after solidification and consequently unable to overcome the resistance offered to its contraction by even the best made mold or core; or to sufficient thought not being given during the manufacture of mold or cores, to the need for the least possible resistance to the contraction of the cooling metal. In the first case the most likely enemy is sulphur, which if present in large quantities, particularly if manganese is low, causes a definite state of red-shortness.

Causes of Blow Holes

In the latter case, too fine a grade of sand or too high a percentage of bonding material causing the mold or core to ram too hard and close, and if dried to consequently bake like a brick. It also may be caused by the failure to provide brackets or chills on portions subjected to undue concentration of stresses due to irregular design, or by the use of such cross bars in the molding flask, which prevent the free contraction movements of risers, etc; or by the neglect in certain cases to release the tops as quickly as possible after casting. These are all points for consideration when attempting to elucidate the causes of such cracks.

Draws or contraction cavities are inevitably due to lack of proper feeding, either owing to molders' shortcomings or to such complication of design that

portions requiring feeding are inaccessible. In the former case the remedy is obvious, but the latter, in the author's opinion, occurs with much greater frequency than it should, and calls for still closer co-operation of the designer and foundry. During a considerable period devoted to the consideration of defects in steel castings, the author has been impressed with the general appearance of ambiguity where their initial causes were concerned. Defects of one and the same kind appear to have arisen possibly from any one of a variety of causes; which state of affairs has been somewhat fostered by the more or less general practice of separate control of mold and metal production. Scientific research applied to the problems associated with the production of the various forms of worked steels, has resulted to a large extent in the elimination of this ambiguity where everyday defects are concerned, and in most cases they can be definitely alloted a cause. However, the problems of the foundry, probably owing to the great number of variables which enter into the production of a casting, do not appear to have had, up to the present time, the same scientific investigation, and are consequently often assigned to some cause or other on mere visual appearance, which may be grossly misleading.

Few steel foundries are in such a position as to be able to afford a full scientific control and the necessary exhaustive investigations. Their only hope is in some form of communal research organization, or in one such as the British Cast Iron Research association, which, it is safe to say, is now dealing with the solution of problems in an organized scientific manner, which have existed during the whole history of cast iron, and have been dealt with previously by rule of thumb, or haphazard assumption.

The author believes that no such organization exists in Great Britain where steel castings are concerned, and would suggest that its formation, or the possible future extension of the scope of the above mentioned associaton to include steel castings, would prove a great boon to the smaller steel founders, who with every desire to improve their product, are unable to avail themselves of the necessary knowledge and appliances to bring science to bear.

Safety in Electric Welding Practice

BY D. H. DEYOE

FOR protection of the operator and of men working in the vicinity of electric welding and cutting operations, it is necessary to take certain precautions. If these precautions are taken, arc welding becomes a perfectly safe occupation. At present, some 60,000 welders are using the arc. We have several welders at our plant who have worked steadily with the arc for six or seven years without any apparant bad effect. In ordinary arc welding, where currents ranging from 50 to 200 amperes are used, simple precautions are necessary for protecting the operator's eyes and the exposed portions of his body.

The usual method of protecting eyes is a face shield or head mask with glass window inserts, the glass of which is of such composition as to absorb the injurious ultra-violet and infra-red rays. When several welders are working in the same room, in addition to the use of face shields or head masks, colored glasses with side protection are worn to protect the eyes of each operator from the arcs of the others.

All exposed parts of the body are subject to a burning effect from the rays of the arc. This burning is similar to a sunburn and if the body is not protected by a covering of some kind it will cause the operator more or less discomfort or pain. The body is usually covered by ordinary close woven clothing and the hands by leather gloves, not only to protect against the rays of the arc but against flying particles of hot metal. The gloves further protect him in handling hot parts. In heavy carbon arc welding and cutting, where currents from 900 to 1000 amperes are used, it is necessary to protect the operator still further, as with these heavy currents the arc rays will penetrate the ordinary clothing and the flying particles of molten metal will burn through them. Usually a large, well fitting leather or asbestos apron is used.

For the protection of men working in the near vicinity of an arç welder opaque screens should be placed between the arc and the workers, or better still, a booth should be built around the operator, shutting off arc rays from the surrounding part of the factory.

Care has to be taken regarding the painting of the interior of an arc welding booth. If a paint that reflects the rays of an ac is used the operator may be subjected to eye flashes from the side and back of his face shield, or to burning the back of his neck or ears. A paint should be used on the interior of a booth and all machinery in it that will absorb the dangerous rays. A satisfactory paint for this use is zinc oxide and oil tinted with lamp black.

Where heavy welding or cutting is being done and where galvanized iron or steel or oily materials are being welded, it is desirable to provide ventilation ducts or fans to carry away fumes.

In metallic arc welding where direct current is used with an open circuit voltage or 40 to 60 volts and welding voltage of 20, it is not necessary to pay much attention to protecting the operator from shock. With alternating current welding this is more serious as the operating voltage ranges from 100 to 175 volts. If the operator is not careful while changing electrodes this may give him quite a shock. There is no way to protect against this voltage as he is in direct contact with one side of the circuit in handling his work and with the other side of the circuit in inserting his electrode material. He must, in turn, be careful not to get in contact with both at the same time. The condition applies to resistance welders used for railway work where the trolley voltage is 450 to 630 direct current. In this case it is necessary for the operator to be very careful to keep free from grounds while changing electrodes. Welding resistors used in railway welding are sometimes provided with a push button station under the control of the welder for opening a contactor in the welding circuit while changing electrodes. But many welders object to carrying around this push button station.

In many installations where a large number of small articles are welded, particularily with the automatic welder, instead of building a booth around the operator to protect outside workers and instead of providing the operator with a mask or face shield, an inclosed cabinet is built around the operation itself, with a colored glass protective window through which the operator can watch the progress of the welding.

Where many welders are working on small work it is customary to build a series of small booths which are open and extend above the operotor's head, the front being supplied with the welding control apparatus and with a bench on which material to be welded is placed. The backs of the booth are protected with a series of curtains which are closed before starting to weld.

For the protection of welding apparatus, safeguards, such as are applied to apparatus of similar nature, are used, circuit breakers, contactors, fuses, enclosed switches, enclosing boxes for control apparatus, insulated couplings gear mases, and insulated holders.

Bill Points To a Great Variety of Methods

BY PAT DWYER

CERTAIN events and incidents cling to the memory longer and more clearly than others. I have particular reason to remember a day in the early summer of 1914 when a smooth, elegant and eloquent specimen of the book agent fraternity breezed into the foundry at the noon hour with, absolutely gentlemen, the most unique, wonderful and unparalleled offer ever made by a publishing house in this or any other country. He had with him something that never before had been attempted, something that probably never would be duplicated, at least in our generation and certainly, my dear friends, something that never would be surpassed in style, binding, reader interest, solid worth either on a dollar and cents basis or by any other test you choose to employ.

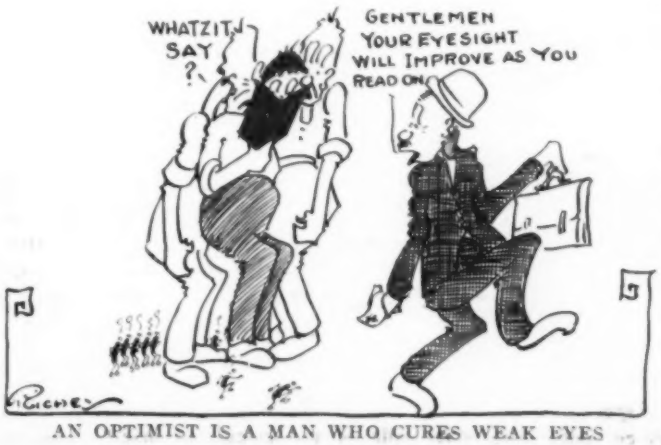
He Was Good

He directed attention to the cover, the paper, the number of pages, and in contrast to the insignificant price at which he was enabled to offer the volume for a limited time; he quoted the practically prohibitive price attached to any of the regular editions where the author's works were presented in a series of at least 50 individual and separate volumes. This was his first and probably would be his last visit to the community and any person who failed to avail himself of what might be regarded truly as a special dispensation of providence would only have himself to blame in the future when bitter experience made him realize the truth of the great poet's words, page 793-er-let me see—Oh yes, "My horse, my horse, my kingdom for a horse!" You know-er-symbolizing the fabulous value we attach to something when it is beyond our reach.

He repeated the foregoing, as nearly as I could judge, in a single breath. I don't know how he did it, but I remember I envied him in the same manner and for the same reason I have envied the skill displayed by men who can swim long distances under water, men who can play long, difficult passages on a wind instrument either reed or brass and—in former days—men who could drain a beer can in one long, thrilling, ecstatic draught.

He flipped the pages and made a running comment on the contents as he proceeded and I was somewhat surprised to learn that the book contained a complete set of the works of the late Mr. Shakespeare. At the time I was not sufficiently interested to make a personal examination. I assumed that this 100 per cent go-getter merely was exercising his toreador's license which entitled him to shoot with both barrels. Later I learned he was telling the truth. Not the plain unvarnished truth, but the usual brand of everyday truth in which the sterling old virtue is adorned and bedecked according to the taste of the purveyor.

The letters forming the text were the smallest I ever have seen with the exception of those showing the Lord's Prayer on a grain of wheat which I saw on exhibition one time and which I considered a singularly inappropriate piece of work. As an evidence of painstaking skill it was worthy of admiration, but as an example of a petition for the daily bread—well—any publicity agent could tell you off hand that it never would win past the second assistant outside doorkeeper.



AN OPTIMIST IS A MAN WHO CURES WEAK EYES

Tricks of the Trade

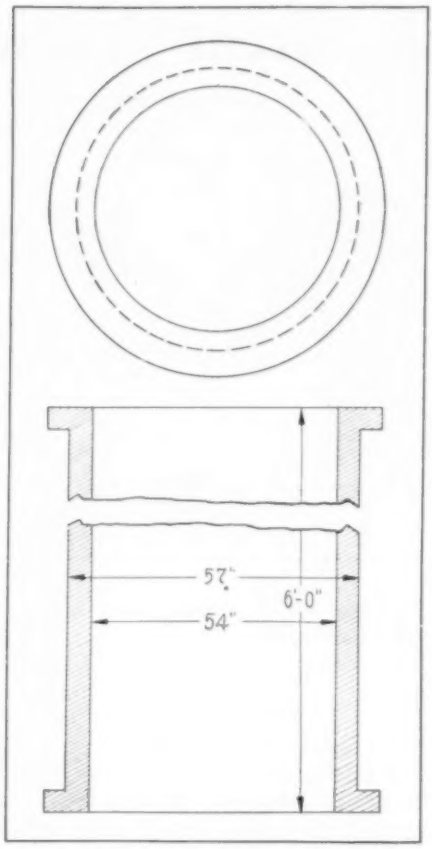
The letters in the book were so small that I was moved in after years to wonder if the compositor had used a microscope while setting the type. Recently I consulted a master printer on the subject and learned that when it comes to tricks of the trade the printers—as Bill says—have it all over the molders. He explained that the book originally was set up in 8 or 10-point, then each individual page of type was photographed, the photograph was reduced and plates were made. The edition was printed from a set of these plates. Simple, Eh! What?

Several times since, the thought has occurred to me that the foundry industry would undergo a wonderful revolution if some inventive genius were to develop a method somewhat along the same line for producing, say, a dozen sizes of gears, or pulleys, or pipes from one original master pattern. The book was printed on paper of approximately the same texture as that employed for cigaret wrappers and although it ran over a thousand pages it was bound between a pair of covers less than 1¼ inches apart. What motive prompted this particular book agent to

select a foundry as a possible market place for a book of that character is beyond my comprehension. It may have been due to youth and inexperience or it may be that he was one of those persevering persons who see a prospect in every human being who has arrived at an age when presumably he, she or it is able to read. Again he may have been one of those intensely practical, mathematical lads who reduce every condition and circumstance to a formula of some kind and figure on making a definite number of sales per thousand interviews. I did not ask him any questions touching on his private system and he volunteered no information on the subject. He was a nice friendly young fellow for all his volubility and for his own peace of mind and financial future I hope he had few foundries on his list. He finally hypnotized one of the apprentices into signing an order for a copy of the work before the starting whistle blew at 1 o'clock.

I acquired the book later in the same year in an interesting and pathetic manner. Conditions connected with a famous and historical scrap of paper caused Britannia to don the old battle armor and fling the blood red banner to the hurricane of war that formed and roared over Europe for four long sanguinary years. The echoes of her brazen bugles resonant, reverberating, penetrated to the most remote fastnesses of her far flung empire and caused hundreds of thousands of her loyal sons to drop everything connected with their ordinary avocations, to don the khaki, to commandeer every available form of conveyance and in answer to an uncontrollable impulse, old as the history of mankind, go storming home to the mother land across every one of the long, long leagues of the seven seas.

My young apprentice friend was among the first to answer the call that aroused the spirit of adventure in riotous youth. He joined the 17th field



SECTIONAL AND TOP VIEW OF CASTING

battery that later was merged with the 85th battalion, one of the first units in the Canadian expeditionary force.

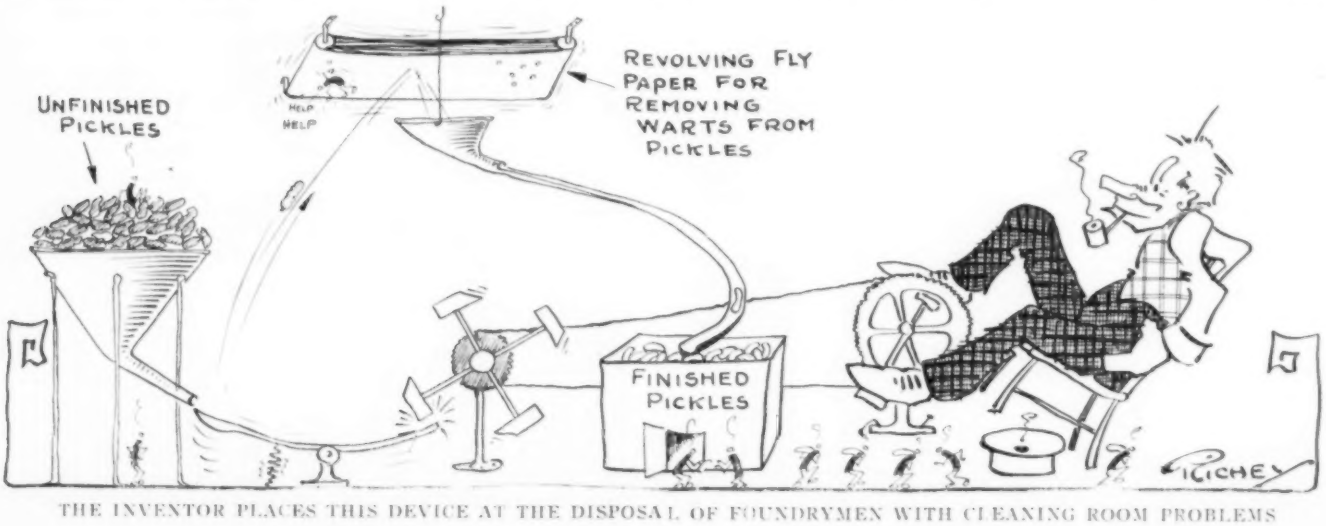
The town was aflame with excitement in those days and the spirit of the people was crystallized in the refrain of one of the more famous of the many war poems:

We are English as the English,
Though the broad seas roll between.
We are Irish as the Irish
Who are soldiers of the Queen.
We are Scotch as any Scotsman
In the town of Aberdeen;
But we're Britons when the call is ALL HANDS!

Dressed in his natty uniform, cap cocked at a ferocious angle, and with a little stick carried jauntily in his hand, the young soldier swaggered into the foundry the day before his battery departed. He bade us all goodbye and gave me the copy of Shakespeare with a laughing admonition to hold it until his return. Each time I have picked it up since I see again his innocent boy's face, his saucy grin and the debonair wave of his hand and—well—he was killed in his first engagement.

I have derived a considerable amount of pleasure from reading the various plays. On occasion I have been persuaded, easily, to accompany the older children to see dramatic versions. Last week a distinguished actor, accompanied by what the papers and posters announced as an exceedingly able and competent supporting cast appeared in one of the downtown theaters and I proposed to Bill that we should go down Thursday night to see him impersonate Hamlet, prince of Denmark.

"Not me," said Bill. "When I go to a show I want to laugh and enjoy myself. I see, hear and read of enough sordid details of tragedy in every day life without throwing up 8 bits to sit up in the last row in the gallery and see it portrayed for two hours on the stage. My antipathy to this particular play dates back to my school days when I was bullied and brow beaten by an old crab of a school master into committing to memory Hamlet's famous soliloqy 'To be or not to be.' At that time I considered Hamlet a nut and I felt like another nut while standing on the platform at the annual examination exercises, stumbling through the lines. My feelings were not improved to any noticeable extent by the dumb show applause I was accorded by several precious members of my own gang perched in the back seats. For several weeks thereafter I had a fight on my hands practically every day in trying to convince individual members of the same



THE INVENTOR PLACES THIS DEVICE AT THE DISPOSAL OF FOUNDRYMEN WITH CLEANING ROOM PROBLEMS

gang that I did not appreciate their efforts in giving a highly burlesqued imitation of my performance. To be or not —Bah. Never again for me.

"The play begins with a ghost—no, not a goat—a ghost and only ends when practically the entire cast either has been murdered or has committed suicide. Right cheerful stuff, I calls it. The hero pretends to be a lunatic and acts the part with great gusto as a means to accomplish his revenge. He runs his sword through his prospective father-in-law, a fairly harmless old gink; forces his mother and step father to poison each other; indirectly causes the heroine to lose her mind and while in that condition she drowns herself. He fights a duel with another lad who is armed with a poisoned rapier and although he puts the other out of business, he himself receives a scratch from the poisoned rapier point that causes him to die quite gracefully in the center of the stage, well down toward the footlights so that the spectators may observe the expressive play of his features down to the last gasp. Outside of these trifling details the action of the play is quite cheerful.

The Cheerful Grave Digger

"The heavy mantle of gloom that hangs over the play—what a term!—is lifted in spots, as for instance, one scene in which an old sexton and his venerable assistant are shown digging a grave amid the gruesome surrounding features of a cemetery. The sexton turns a skull up with his spade and recognizes it as that of Yorick, the king's jester, whom he had buried 27 years before. He picks the skull up in his hands for a more minute examination and confides a few intimate details to his striker. 'Alas! poor Yorick,' says he, 'A fellow of infinite jest. I knew him well.'

"I don't like that particular play," Bill continued, "but I am perfectly willing to admit it is a fine piece of dramatic workmanship. Taking Shakespeare by and large probably I entertain as sincere an admiration for his genius as any person who either has read his works or has seen them portrayed on the stage. I have admired his comprehensive knowledge of the manner in which mankind is swayed by its emotions, love, passion, prejudice, loyalty, jealousy, fear, anger and revenge; but even to a greater degree I have admired the versatility he has displayed in incorporating these features in almost endless combinations.

"At first you might think there is little in common between a foundryman and the immortal bard of Avon, but in this attribute of versatility, in his own line the former is no slouch. Under the press of circumstances and to meet local conditions he will make the same casting according to a practically unlimited number of methods. Consider a typical instance, a piece of flanged pipe 6 feet in length, 54 inches inside diameter and with a metal thickness of 1½ inches. Off hand, I can list at least 21 different combinations by which the job may be molded and I am quite confident these do not exhaust the possibilities. Roughly speaking the mold may be made either vertically or horizontally from a spindle and sweep, a whole pattern or a skeleton pattern and each of these methods are subject to almost endless subdivisions and modifications. A few of the methods illustrate the adaptability of the job.

Consider the following:

"1. The outside of the mold is swept vertically in loam. It is parted at the bottom and removed temporarily while the inner part of the mold is being built on the same foundation plate. The only pattern equipment required for this and several succeeding methods is a pair of sweeps and either a flange pattern in segments or a flange corebox. Segment cores from this box are built into the wall top and bottom.

"2. The outside wall and bottom of the mold are built as a unit on a foundation plate and allowed to remain undisturbed. The inside part of the mold is built on a second plate provided with suitable lifting hooks and after it has been dried it is lowered into its proper position inside the first part of the mold. This method usually is adopted where the job is wanted in a hurry and also where two men and two spindles are available.

"3 to 8. The mold is swept either in green, dry or skin dried sand. The particular method employed will depend to some extent on the quality of the available sand and also to some extent on the purpose for which the casting is intended. The mold may be made either in the floor or in a flask. If it is made in the floor, the core is swept first and lifted out of the way while the outer wall of the mold is being prepared. If the mold is made in a flask the procedure is reversed. The check is swept on a prepared drag and then removed to suitable stands where it is finished and blacked while the core is being built on the drag. Afterward it is returned to place to form the complete mold with the exception of the cover. On any of the swept molds the core may be made according to any one of three different methods. It may be a loamed plate, a set of flat segment covering cores or a plain cope rammed on a flat plate.

"9 to 16. The mold may be made either in the floor or in a flask in green, dried or skin dried sand by utilizing a comparatively shallow ring pattern which is drawn successively after each ramming until the desired height is reached. The flanges are formed by flange cores or by suitable segments cut on the band saw. If the job is made in the floor the inside is lifted out on a circular plate. If made in a flask the cheek is lifted off in the manner previously described. The patternmaking cost attached to this method is only slightly in excess of that involved in preparing a pair of sweeps. Frequently no new pattern is required. An existing ring pattern may be lagged or otherwise adapted to serve the purpose.

"17. The mold may be made horizontally from a skeleton pattern which serves for both pattern and corebox. A heavy cast iron arbor fitting in the bottom of the pattern serves to support the entire core which is lifted out finished and replaced after the pattern is removed from the mold. This method involves the preparation of a pattern for the casting and a second pattern for the arbor. In addition, a special cope has to be provided with bars conforming to the contour of the pattern. This feature must be reckoned in any of the following methods where the casting is molded horizontally. Precaution also must be observed where a cast iron arbor is employed, to prevent distortion of the casting.

"18 and 19. The mold may be made horizontally from a full pattern and a half corebox. The core may be either green or dry sand or a combination of both, that is a dry sand bottom half and a green sand top.

"20. The mold may be made horizontally from a full pattern and the core may be swept in loam on a suitable core barrel.

"21. The sand or loam core may be made first and then used as a pattern by attaching suitable flanges at the proper distances apart and by employing narrow wood lagging strips to correspond to the required thickness of metal."

Looks Like a Good Job

"If you continue," I said, "You will discover as many methods of making that pipe as the pickle king has discovered for making pickles."

"Well," said Bill, "I'll tell you. The pickle business has possibilities, although perhaps not along the lines you have in mind. As becomes a prudent man I have begun to think seriouly of taking up some light form of business in which to spend my declining years. After serious consideration I have narrowed the choice down to two. I have not finally decided whether to get myself a job grinding the warts off pickles in a pickle foundry, or to become a bootlegger. The first appeals to me on account of the minimum amount of physical labor involved, but the latter, as I gather from what a man told me recently, offers greater financial returns. This man who is in the tire business recently called on a prominent colored bootlegger who owns several large, shiny, expensive automobiles and my friend called with a view of soliciting part or all of his patronage in new tires. The purveyor of liquid cheer listened to his plea with amused tolerance. 'Go 'way man, an' doan waste yo' time, said he, 'Ah doan nevah buy no tiahs. When ma tiahs weahs out Ah buys mase'f a new cah!' "

Offers Assistance to Welding Schools

Work of the educational committee of the Gas Products association, 140 South Dearborn street, Chicago, is taking the form of a general movement to render personal service to principals of welding schools and welding instructors through the medium of representatives and service men in the territories served by the various schools.

The committee has adopted a schedule of instruction covering the knowledge and skill to be acquired by the student welder to make him a satisfactory apprentice. The association recommends a definite amount of instruction in the school, and offers assistance in arranging courses to cover the amount of ground indicated. In cases where the stipulated amount of instruction is given, the name of the school will be placed on an accredited list. Every effort will be made to decrease the cost of instruction in accredited schools by supplying apparatus and gas at the lowest possible figure; to provide desirable positions for graduates from these schools through the recommendation of representatives who are in touch with the needs of employers, and to secure students for these schools by solicitation, and by advertising. The co-operation given to welding schools is not limited to those on the accredited list of the association, although in the case of such schools, extra effort is made to help maintain the standard of instruction at the highest possible level.

The committee is prepared to render personal service in all cases where it is requested. By means of special bulletins, the committee will furnish all schools which desire such service, with information and suggestions on the conduct of a training course, and act as a clearing house for ideas which will be helpful in this work.

How Belgian Sands Are Made Available

Belgian steel molding sands are exported to Great Britain and even to the United States on account of desirable properties, including a natural bond. The heavily bonded sands known locally as *gras* and *demi-gras* are found near Charleroi. They occur in regular pockets which are practically on the surface, having a maximum depth of 20 feet. These pockets rarely are more than 900 feet in diameter. The sand is loaded by hand into carts from which it is transferred to railroad cars. If exported it is transferred again to ships. Prof. P. G. H. Boswell of the University of Liverpool, one of the leading British molding-sand experts, says, "It is my belief that this continuous rehandling is the only way, expensive as it may seem, by which the shippers secure uniformity in their consignments."

These sands are known as Belgian red and Belgian yellow. The sand pockets are surrounded by carboniferous limestone and coal measurers. The sands are found in the form of an irregular mixture of clays, clay-bonded sands, and sharp sands. Therefore, the working proceeds somewhat irregularly and the area of land required per ton of output is large. The clay bonded sands are the ones which are selected for molding, but some of the sharp sands are mixed with them during the process of handling described above.

The less strongly bonded Belgian sands are found around Peissant. They are regularly bedded and contain some large boulders. A large portion of these sand deposits is heavily wooded, the forest of Hainault being located in this district. The sands are close to the surface and are easily and cheaply extracted. The sand is dug by hand and by machinery, and is transferred by cart to the nearest stations where it is put into railroad cars. The usual depth worked is 10 to 20 feet and the deposits cover a very large area. The Peissant sands are extensively exported.

Book Review

The Manufacture of Electric Steel; by Frank T. Sisco; cloth, 304 pages 6 x 9 inches, published by the McGraw-Hill Book Co., Inc., New York and furnished by THE FOUNDRY, Cleveland, for $3.00, net.

Intended to fill a need existing in the steel industry, this work aspires to furnish a complete treatise on methods of making electric steel. From the selection of scrap to teeming the ingots the method and process is made the important consideration. Various electric furnaces are described briefly, most emphasis being put on such details as are of most importance to the metallurgist and the man at the furnace. Throughout the book the author has held to the opinion that high quality is the essential consideration in electric steel and his directions and conclusions all are based on that essential. Simple language has been employed so it may be understood by the man who operates the furnace, the melter and his helpers. In this endeavor the colloquial has been used in some instances. Both acid and basic practice are discussed. The book deals directly with the detail of the actual making of a heat of electric steel.

Safe Practice in Wood Shops Considered

Among the papers which will be presented at the midyear conference of the National Safety council's engineering section are the following which will be of interest to operators of pattern shops:

FEBRUARY 19

Session at 10 a. m.

"Safe Layout of a Woodworking Plant or Department," by A. S. Kurkjian, Oliver Machinery Co., Grand Rapids, Mich.

"Use and Care of Saws," by S. H. Disston, vice president, Henry Disston & Sons Co., Philadelphia.

"Fire Protection for Woodworking Plants and Lumber Yards," by John Plant, chief engineer, bureau of fire prevention and public safety, Chicago.

George E. Sanford, General Electric Co., West Lynn, Mass. will preside at this session which will be held at the Morrison hotel, Chicago.

Sell Newark Plant

Announcement has been made that the foundry of the Crocker-Wheeler Co., Newark, N. J., has been sold. The name of the purchaser was not divulged because of certain reorganization plans that are under way but this announcement will be made shortly. The foundry was erected several years ago by Edward Maher's Sons for the manufacture of gray iron castings and was one of the most modern plants of its type in that district. During the war when it was impossible to get castings, the Crocker-Wheeler Co., purchased the plant to facilitate its business. Capacity of the plant was 25 tons per day. The sale of the plant includes all the equipment with the result that the purchasers will be in a position to start production without delay. The ground consists of about two acres and the buildings cover about 35,000 square feet of floor space. The property is located on the Newark and New York branch of the Central Railroad of New Jersey and is served by two private railroad sidings.

Advocates Revision of Sherman Law

The National Association of Cost Accountants through a resolution adopted by its board of directors copies of which have been sent to the President of the United States and to the members of both houses of Congress, has taken a definite stand in favor of a revision of the Sherman anti-trust act and subsequent legislation, insofar as it affects the activities of trade associations in exchanging among their members statistics and trade information.

A. M. Thomson has been made representative in the Philadelphia district for the Hauck Mfg. Co., Brooklyn, manufacturer of oil burning appliances.

Melts Borings and Turnings

Briquettes Formed in Special Press Using Clay Water Binder Successfully Used in Producing Hydraulic Castings—Influence of Elements Described

BY J. ALEX GARDNER

VARIOUS schemes for melting borings and turnings have been tried from time to time. These include packing in boxes made of metal or wood, bonding by rusting, or by Portland cement. The first of these plans entails the destruction of the container long before the mass of the borings or turnings is fritted together, with the consequent ejection of the particles, from the cupola by the air blast. The second is a slow process, even when accelerated by the use of ammonium chloride, and must by its nature involve excessive stocking and handling.

Briquetting machines are on the market, and are said to work well. Working at pressures from 100 to 150 tons, with an output of 1000 to 1500 bricks per hour, when working on such material as sand, coal and coke. In a typical example, Fig. 1, the pressure is applied by toggle levers driven by gearing, and the press requires 10 to 15 horsepower to drive it. On inquiry we found that the cost is over $6000 for a new machine, and more than $4000 for a reconditioned one.

Starting from this point we experimented on compressing the borings and turnings in taper tubes with a bond, finally getting a good briquette 3½ inches in diameter at the broad end and 3¼ inches at the narrow end, with an overall length of 6½ inches. The briquettes thus formed can be handled easily, and are transported to drying ovens. After being dried, a briquette can be dropped from a height of about 20 feet upon hard material, and possibly may break into two pieces, sometimes more, but it does not disintegrate. This briquette was obtained by filling a taper tube 13½ inches long, the lower length of 6½ inches conforming to the dimensions of the finished briquette. This tube was firmly packed by hand with the borings and turnings mixed with a sufficiency of clay water, the clay water being the consistency of thick cream, and the quantity of it adjusted until little of it is squeezed out by ramming.

Ramming consisted of applying about 35 tons to the mass contained in the taper tube, by a ram 3 inches in diameter, the other end being effectively closed against squeezing out the borings, but not against the surplus clay water. The briquettes thus formed in this case were dried on the floor round the carriages of the stoves used for drying loam and drysand molds, thus involving no additional outlay for this part of the process. We then proceeded to design a simple semiautomatic machine which could effect the manufacture of these briquettes. In the meantime, we made 1680 pounds of mixed turnings and borings into 213 briquettes as shown in Fig. 2, and the resultant weight was such that the added clay weighed 93½ pounds, or 6.3 per cent of the whole, and the average weight of the briquettes was therefore 8¼ pounds.

These briquettes were melted in a small cupola, with a 12-inch water pressure air blast, and cast into pigs, the yield showing a loss of 11.1 per cent. The borings contained dirt from the floors, etc.

An average sample of the borings before briquetting showed the following analysis:

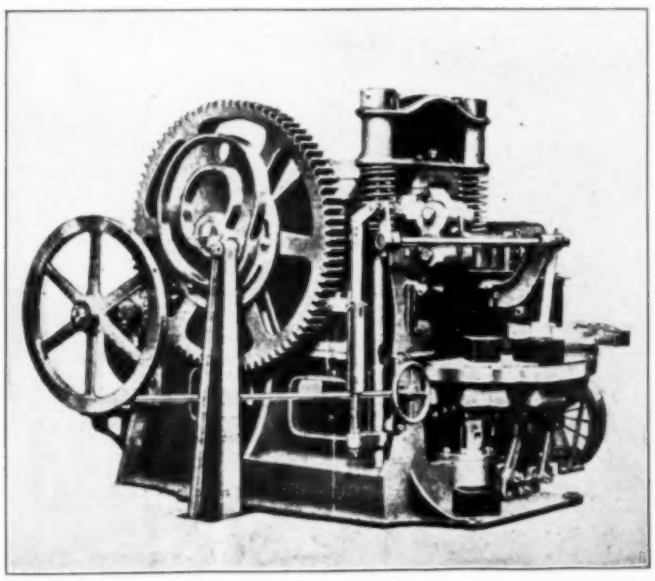
	Per Cent
Silicon	2.187
Sulphur	0.062
Phosphorus	0.682
Manganese	0.528
Combined carbon	0.400
Graphitic carbon	2.88

After melting the pigs showed an analysis as follows:

	Per Cent
Silicon	1.305
Sulphur	0.193
Phosphorus	0.716
Manganese	0.171
Combined carbon	2.115
Graphitic carbon	0.560

The resultant iron was white owing to what had evidently been a combina-

Abstracted from a paper presented at a meeting of the Scottish branch of the Institute of British Foundrymen, held in Glasgow. The author, J. Alex Gardner, is foundry engineer for Glenfield & Kennedy, Kilmarnock, Scotland.



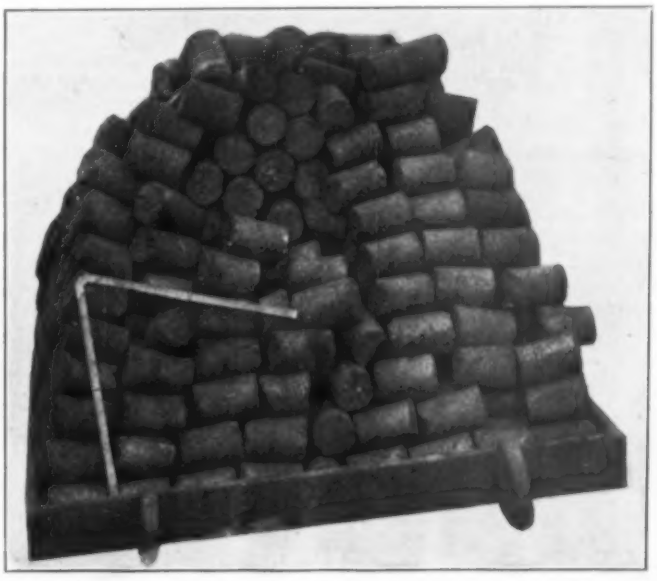


FIG. 1—COMMON TYPE OF BRIQUETTING MACHINE USING TOGGLE JOINT LEVER PRINCIPLE FOR COMPRESSING MATERIALS. FIG 2—BRIQUETS FORMED WITH CLAY BINDER

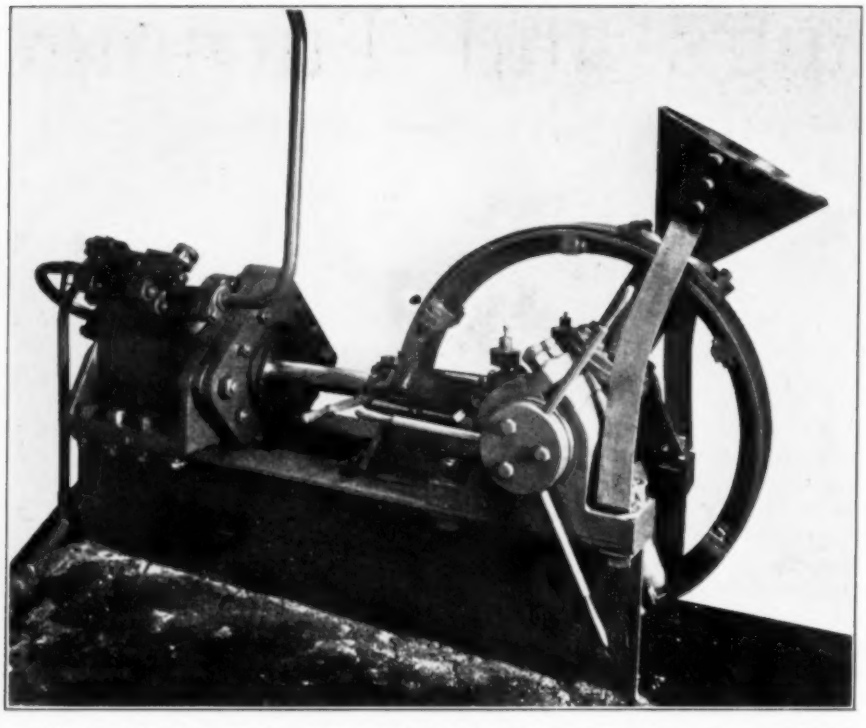


FIG. 3—MACHINE USED FOR FORMING BRIQUETTES WITH CLAY BINDER

tion of the alumina in the clay used in briquetting with part of the silicon content of the turnings and borings, slagging off as one or more of the silicates of alumina.

Having thus obtained a reasonable return from the cupola insofar as quantity is concerned, and noting that a suitable addition of high silicon, or silvery iron as it is called, would rectify quality, we then concentrated upon building a machine which would turn out the briquettes at a reasonable speed. A hopper gives direction to the borings and turnings which have already been mixed with clay water as shown in Fig. 3. We store our clay water in a tank which is kept agitated and mixed by a small jet of air rising from the bottom. The succeeding cylinders thus are filled with the clay and boring mixture as they pass under the hopper. The first cylinder having been filled, the three cylinders are rotated, the second is now filled and the first is brought in front of the compressing ram. A pressure of about 85,000 pounds is developed inside the hydraulic cylinder behind the ram which, allowing for frictional and other losses, will represent about 78,000 pounds effectively applied to the borings, or about 11,200 pounds per square inch of end surface of the briquette. The internal pressure on the cylinder is about 1120 pounds per square inch when pressure is on.

The cylinders are locked in position during the compression period. The hydraulic supply to the machine is controlled by a valve. The cylinders are again rotated when the third one is filled with borings, the second coming in front

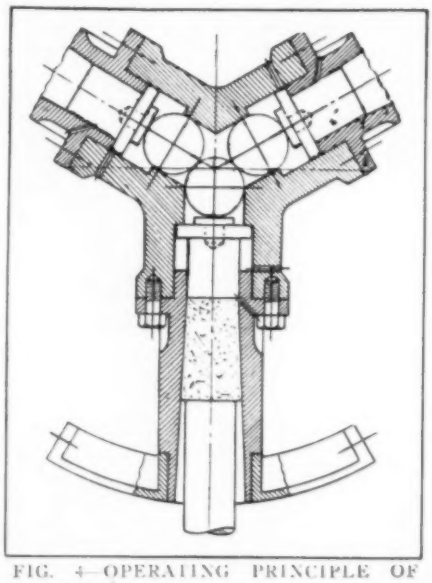


FIG. 4—OPERATING PRINCIPLE OF MACHINE SHOWN IN FIG. 3

of ram, which when it functions, not only compresses the borings in this second cylinder, but at the same time by a system of three balls as shown in Fig. 4, acting in a wedging manner on well fitting pistons at the bottom of the cylinder, ejects the contents of the first cylinder as a formed briquette upon a suitably curved plate which slides it to the floor.

The briquette we thus obtained was a homogeneous mass about 6 inches long, by about 3½ inches in diameter at the broad end, tapering to about 3 inches at the narrow end, and weighing when dry on the average 5¾ pounds.

A reasonable speed of production with three individuals when they have to mix the borings and clay water together and operate the machine is 940 briquettes per working day, weighing about 6200 pounds but when the same individuals have to transport the briquettes to the drying ovens, the production runs about 760 briquettes per day, or a weight of 5000 pounds.

The greatest wear in the machine naturally is located in the tubes in which the briquettes are compressed, the taper being gradually worn parallel. However, we can get about 21,582 briquettes per tube before they are useless through not ejecting properly.

As the briquettes are made, and immediately upon leaving the machine, their temperature rises about 60 degrees Fahr. above the atmospheric temperature, the briquette steaming slightly. Clay water is as yet the only medium with which we get this rise in temperature under the conditions stated after compression. With all other materials we have tried, the press grunts heavily during the application of the pressure, showing heavy frictional resistance to movement of the particles of the mass past one another, with the result that the briquette is not so homogeneous, neither can it be safely handled in transport before drying. I attribute the successful functioning of the clay water to the gelatinous nature of the hydrated oxide of aluminum, its chief content, whereby it, to a certain extent, acts as a lubricant.

The formed briquettes are allowed to attain a primary set for about 2 to 3 hours, and then are placed on the floor round about the cores, loam and dry-sand molds in our drying ovens. After

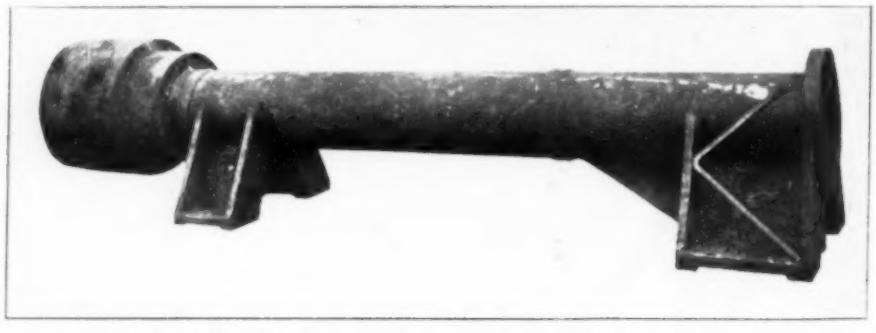


FIG. 5—A CYLINDER FOR A HYDRAULIC MACHINE WAS CAST FROM METAL MIXED WITH THE BRIQUETTED MATERIAL

about 12 hours heating, the briquettes are quite dry, the alumina has been dehydrated, and the whole mass is found to be reasonably hard, and quite suitable to withstand the shock of falling down the barrel of the cupola when charging, that is, they may or may not break into two pieces, but they will not be disintegrated into useless powder.

We ran the machine until we had produced 827 of these briquettes. Taking the clay content at 6.5 per cent, we divided into three charges and placed in the cupola, the following:

	Pounds
Briquettes	4704
High silicon iron	2240
Good scrap	2240

At the same time we added a little more than the normal amount of coke and limestone.

The scrap used ran about as follows:

	Per Cent
Silicon	2.400
Sulphur	0.040
Phosphorus	0.700
Manganese	0.800
Graphitic carbon	2.920
Combined carbon	0.400

The high silicon iron showed the following analysis:

	Per Cent
Silicon	6.279
Sulphur	0.072
Phosphorus	0.375
Manganese	1.194
Graphitic carbon	2.380
Combined carbon	0.074

Taking the borings, we have:

	Per Cent
Silicon	2.187
Sulphur	0.062
Phosphorus	0.682
Manganese	0.528
Graphite	2.880
Combined carbon	0.400

We ran the cupola under about 12 inches water pressure, and the metal came down hot and fluid, showing that our extra coke precaution was unnecessary, but, as may be anticipated, the melt was associated with a good quantity of slag.

An analysis made from a 40 x 2 x 1-inch test bar, cast about the middle of the run showed the following analysis:

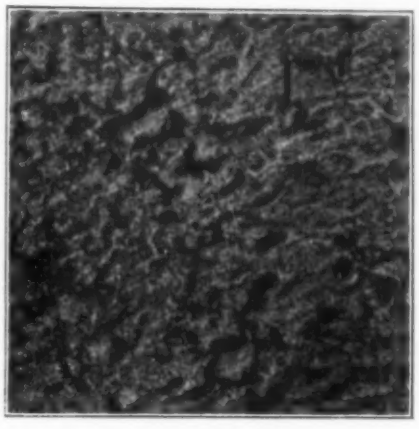


FIG. 7—PHOTOMICROGRAPH OF ONE OF THE TEST BARS

	Per Cent
Silicon	2.365
Sulphur	0.153
Phosphorus	0.667
Manganese	0.457
Graphitic carbon	2.040
Combined carbon	0.645

Three test bars dimensioned as above, broken on 36-inch centers gave the following results:

No.	Pounds	Deflection	Remarks
1	4120	0.436	Slightly flawed
2	4000	0.427	Sound
3	4510	0.432	Sound
Average	4174	0.432	

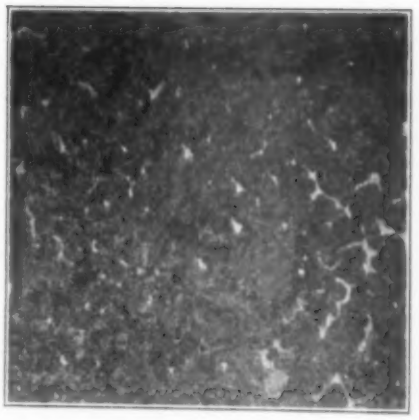


FIG. 8—SAME SECTION ETCHED WITH IODINE

We cast a hydraulic cylinder with this iron. Fig. 5 shows this casting cleaned and as shown it weighs with its head 5152 pounds. The usual slag and dirt were noted at the top when the casting was split, but below the mass of the iron is of fine quality, approaching the old cold blast iron in character, which is describable as of riven oak. Therefore, it is significant of a high degree of solidity and toughness. Fig. 6 shows the turned flange and bore of this cylinder.

The machinist reported that he was conscious of the iron being just slightly tougher than normal, but the cutting speed was not reduced.

A test of the chips taken while boring the cylinder showed silicon, 2.281 per cent and combined carbon, 0.075 per cent.

The lower figure of the combined carbon content is, of course, due to the much slower rate of cooling of the cylinder mass, in comparison with the test bar.

Fig. 7 shows a microsection cut from one of the test bars polished, but unetched. It reveals a finely divided graphite content, and comparatively little impurity. Fig. 8 shows the same section etched with iodine, and revealing the iron phosphide as white areas, with the pearlite as halftone, and also the same small graphite plates. Both illustrations are under a magnification of 84 diameters, and fully substantiate the analysis and results obtained from the test bars.

In my opinion the superior qualities of this metal are due to the mechanical elimination of graphite by the machining process productive of the borings and turnings, and possibly also during the early melting stages, with a

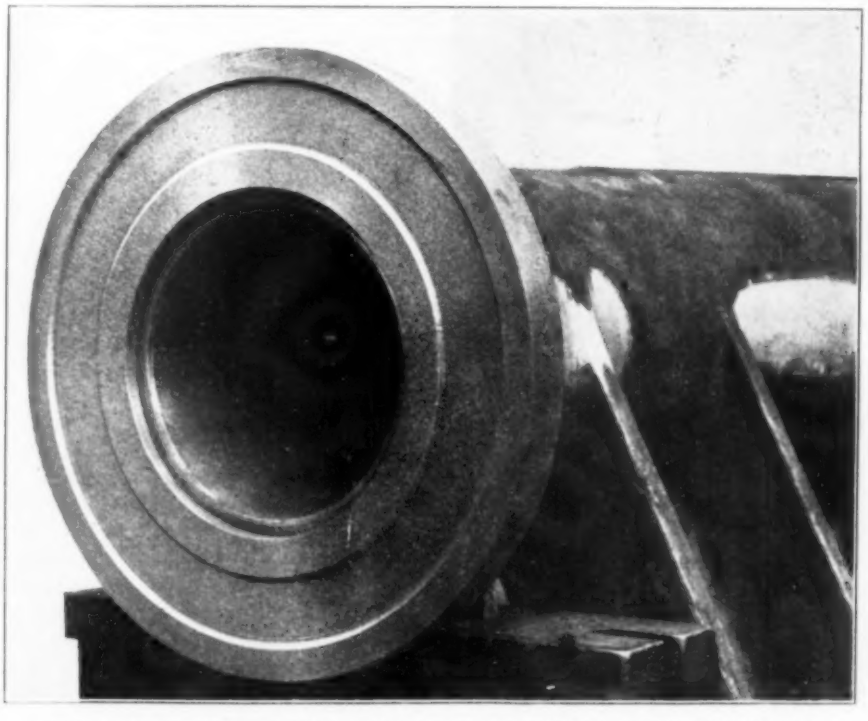


FIG. 6—MACHINED FLANGE AND BORE OF CYLINDER SHOWN IN FIG. 5

consequent diminution of the length and number of possible cleavage planes in the mass. In this way our product is similar to semisteel. A daily use of briquettes when such are available in quantities varying from 5 to 25 per cent, has been proved to increase the strength of cast iron. They appear to function in an almost exactly similar way to steel, although perhaps in the higher percentages, steel is in the ascendant owing to its dilution of the sulphur and phosphorus content. We have had transverse tests on a 2 x 1-inch bar on 36-inch centers of 5152 pounds in semisteel.

We confine ourselves to the fixed volume of air method of control in the cupola. So many variables affect the functioning of a cupola, that we feel it advisable to have one fairly constant factor. Therefore, we work as nearly as possible to 32,000 cubic feet of air per ton of iron. Then, if the iron is cold, we know that more coke is required of the quality we are using. If, on the other hand, the iron is hot, but the melting is slow, then too much coke is being used, and we can control accordingly.

For volume control we are using a pitometer tube in conjunction with an inclined manometer, one limb of which is larger in bore than the other. In this way, we get a relatively long sensitive column of water and a fine adjustment of the air is possible.

We find that a pitot tube is inexpensive, does not materially affect the flow of air, is easily fitted, takes up little room, and it is accurate when installed as indicated.

Artistic Bronze Cast in Italian Foundry

BY C. H. GALE

ACCORDING to the autobiography of Benvenuto Cellini he was responsible for the greater part of the artistic metal work produced in his time. Contemporary history would seem to indicate that he was a remarkable artist and the same history is equally explicit in conveying the inference that he was fully aware of the fact. After reading the biography one cannot escape the conclusion that he was equally competent as an artist or a press agent for himself. Even before Cellini's time Italy was noted as the home of the fine arts in painting and sculpture, the shrine to which aspiring artists from other lands made pilgrimages in search of inspiration and to perfect themselves in the technique of their chosen life's work. Even down to the present some of the most beautiful examples of bronze statuary and other forms of artistic castings are made in Italian foundries typified by the Fonderie Artistique of Beneduce, Marinelli & Co., Florence. The company maintains a show room or gallery in connection with its foundry where interesting castings are exhibited ranging in size from miniatures to heroic figures of various descriptions.

The lost wax process, described at various times in past numbers of THE FOUNDRY, is employed extensively in making the molds for the greater part of work of this character. The process is modified to some extent to meet individual conditions, but in general may be described as follows.

ARTIST AT WORK PREPARING THE ORIGINAL CLAY MODEL FROM WHICH THE WAX IMPRESSION IS MADE IN A PLASTER MOLD

A clay model first is prepared conforming in every detail to the desired casting. A plaster mold is made from this model. It is made in two or more sections so that it may be removed readily from the model or pattern. The number of sections, in ordinary foundry nomenclature known as drawbacks, naturally will depend on the size and intricate outline of the pattern. The plaster mold becomes a permanent master pattern from which an indefinite number of wax patterns may be produced and, therefore, the various parts are numbered and matched carefully.

After the plaster mold has been thoroughly dried it is assembled and filled with melted wax which is allowed to stand until it has set to any desired thickness from approximately ⅛ inch for small castings up to ½ inch for the largest. The remainder of the melted wax then is poured out. The plaster mold is removed and a new mold and core are built outside and inside the wax pattern from a mixture of clay, pulverized brick and plaster. Long wax gates attached to various parts of the pattern are built in place during the process of making the mold. The gates all lead upward and terminate in a common basin on the highest point of the mold. After the mold is completed it is subjected to intense heat which not only dries the material of which the mold is composed but also serves the primary purpose of melting the wax pattern. The wax drains away through suitable small openings provided in the bottom for the purpose. Sand is rammed firmly around the completed mold in a pit in the floor. A reservoir is built on top with capacity to hold all the metal required to fill the mold. The runners are stopped until the reservoir has been filled from a sufficient number of crucibles, then they are opened and the metal enters through the various gates simultaneously.

After the casting is taken from the mold it is cleaned and chipped, minor imperfections remedied and in many cases the entire surface is scrapped and filed. The dark brown effect common to nearly all statuary is produced by painting the surface with an acid wash.

Frank D. Chase, Inc., engineers and architects, moved its offices in Chicago from 645 North Michigan avenue to the Central Life building, 720 North Michigan avenue.

Removable Bars Used in Foundry Flasks

Question—We are endeavoring to place our foundry on a working basis similar to the American standards and to that end would like to know if there are any units established for measuring the amount of sand to be rammed in a given length of time either by hand or power; the time required for making a square foot of joint; to draw the pattern, etc. We also should appreciate information on how to arrange our copes to facilitate ramming. We have been accustomed to inserting gaggers closely all over the cope with their upper ends hooked over the cope bars. The result is that the cope, before it is rammed, resembles a forest and it is a difficult and delicate job to ram the sand. In fact, we cannot see how we are going to adapt air ramming to our copes. We have had to prepare special flasks for use on our small air-operated machines and we want to adapt the principle to larger flasks which cannot be rammed on machines and used for molding casts so variable in shape that we cannot, or at least think we cannot, employ flasks without gaggers. Do you think we could get satisfactory results by placing removable bars, or sets of bars, in our standard flasks. These bars would be cut to the desired shape on the bottom, the general idea being to afford the workmen more freedom to employ air rammers, and to facilitate shaking out the castings, an important consideration in the case of steel castings.

Answer—So far as we know, no standards have been established whereby the amount of sand rammed in a given time can be calculated, and the same applies to the other points touched upon in your inquiry. So many variable factors enter into a calculation of that kind that a generalization would not be of any practical value. Any molding machine manufacturer can furnish figures to show the time required to ram the amount of sand required to fill a given size flask but the facilities provided for conveying the flasks to and from the machine determine the amount of sand rammed in a day. In many cases the ramming only occupies a small fraction of the elapsed time required in making a complete mold.

Removable bars, either singly or in sets, are employed extensively in this country, especially in steel foundries, where the number and size of the risers present a problem in shaking out the castings. On large flasks the bars are bolted in place, while in smaller flasks they simply are wedged on the ends. Illustrations, of the two methods have been described in the July 1, Sept. 15, and Oct. 15, 1921 issues of THE FOUNDRY. By employing sand with a fairly good bond, gaggers may be omitted in a great many places where they usually have been considered necessary. The extent to which they may be omitted must be determined by experiment, but after a few trials the experienced foundryman can approximate the minimum number of gaggers required in any cope.

The Iron Products Corp., 41 East Forty-second street, New York, has acquired exclusive rights to use the new patented molding machine for the manufacture of soil pipe. It is said that the cost with the new process will be $2 to $4 a ton lower than by the usual method.

Case Hardens Gray Iron Sample Castings

Results of experiments on case hardening cast iron are reported in a paper presented by H. B. Knowlton at the convention of the American Society for Steel Treating, held in Pittsburgh, Oct. 8 to 12. Samples were heated in case hardening material at 1700 degrees Fahr. and cooled slowly reheated and quenched from 1500 degrees Fahr. Other samples were quenched directly from the temperature of case hardenings. Micrographs show that the specimens before heating in the carbonizing material were made up of a structure containing free carbon, free ferrite and combined carbon in the form of pearlite. The specimens which were heated in the carbonizing material and slowly cooled show in each instance a broad zone at the edge which is largely pearlite, and the combined carbon in these zones is apparently slightly higher than in the original casting. The micrographs of the center of the carburized, slowly cooled samples show much more free ferrite than was in the original sample. The author regards his work as merely preliminary to a more thorough study of the problem, but concludes that the tests demonstrate the possibility of improving the quality of gray iron castings. He found that the best samples in the series were hard and at the same time had a toughness almost comparable with that of a case hardened low-carbon steel. He suggests that the production of such a combination of properties from cheap gray iron might have considerable commercial value.

M. R. Stowell, for many years sales manager for the American Refractories Co., recently has joined the staff of the Vitrefrax Co. Los Angeles, in the capacity of sales manager of the western division covering the entire Pacific coast and southwestern states.

J. D. Gillette has been appointed district sales manager with offices at the General Motors building, Detroit, for the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Mr. Gillette will be assisted by Harold Aber.

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Disseminate Information on Sand

EXPERIMENTAL and research work at present conducted under the auspices of the American Foundrymen's association eventually will result in establishing standardized methods for determining the most suitable grade of sand for any and every purpose in the foundry. A vast amount of work, involving endless detail in chemical and mechanical tests, enters into this investigation and when it is finished it only will represent a foundation on which to build a set of standardized rules for practical application. While it is apparent that this minute and painstaking investigation is essential to determining the fitness of the sand to meet special conditions, it is equally apparent that the average foundryman is not interested in the methods by which the results are obtained. All he wants is a few practical and easily applied tests; tests that may be carried out in the foundry without the aid or assistance of any elaborate apparatus, and by which he may satisfy himself that the sand will meet his particular requirements. Tests of this character form the subject of a paper recently prepared by Eugene W. Smith and published in THE FOUNDRY, Feb. 1.

Even under the most favorable conditions it is extremely probable that many years will elapse before foundrymen generally will familiarize themselves with the subject and reap the benefit of the pioneer work now engaging the attention of the sand research committee.

A brief survey of the foundry industry for the past 20 years will serve to bear out this contention. Also, it will illustrate the statement frequently made that the foundry industry, as a whole, is singularly conservative. Perhaps a more truthful if less charitable characterization in many instances would be to say that it is wrapped in a blanket of apathy and inertia so far as concerns proper sand for specific needs. The steel foundries offer a shining exception to this rather sweeping generalization. Almost invariably they are thoroughly alive to every feature in connection with improved and economical production of castings to meet the most exacting specifications. Indeed for the past few years certain associated firms have carried on an extensive research program, including investigation of molding sand characteristics.

In the gray iron field, many important interests, particularly those engaged in the automobile casting trade and those usually classed as production shops in special lines have investigated the sand question and have succeeded in standardizing the methods and mixtures to a point that insures a high class and a uniform product in the hands of unskilled and semiskilled men. Through a gradual process of experiment, test and elimination they have settled on a grade of sand that requires a minimum amount of attention in the way of artificial venting; a sand that produces a skin on the casting that requires little or no cleaning. In addition, they have developed a method for preparing the sand that practically eliminates the hazard incident to the sand prepared by the individual and sometimes unskilled and careless workman.

However, the foregoing exceptions only constitute a small percentage of the total number of foundries and the remainder seem to betray little or no active interest in a subject worthy of their special attention. Progress notoriously is slow in any line and more particularly when it is confronted as it is in the foundry industrial field with deep rooted tradition and custom.

Trade Outlook in the Foundry Industry

SALES and shipping orders as applied to coke and pig iron constitute a fair measure of the trend of conditions in the foundry world. Based upon these barometers, the market outlook for castings may be characterized as fair with upward tendencies. Pipe shops, makers of sanitary ware, radiator foundries, implement manufacturers and automotive plants have placed orders for these basic requirements and for semifinished materials which indicate their faith in increasing demand for castings. Further, jobbing foundries are sending out hurry calls for shipments of iron, starting tracers in the track of carload lots in transit and ordering coke for immediate delivery.

Implement Expectancy

The outlook for manufacturers of farm implements seems brighter than at any time since the historic 1920 depression. The total volume of business reported by implement makers in 1923 was 20 per cent ahead of the previous year. Replacement needs have become more acute and buying of farm machinery in many sections is over due. The quickening of demand and the anticipation of better implement business in 1924 is reflected in heavy purchases of steel by manufacturers in the Chicago district. This feeling is backed by the firm faith that farmers' condition will be better this spring than for several years past. The price barrier in a measure, has been removed by the realization on the part of the purchaser that the prices are justified on the basis of material, labor and freight costs. Another source of castings demand which shows a more healthful condition is the machine tool industry. Buying has quickened and the issuance of heavy lists by railway shops, industrial plants and other miscellaneous users has brought a hopeful condition in this lame duck branch of the metal working industry.

Prices of Raw Materials for Foundry Use

CORRECTED TO FEB. 8

Iron		Scrap	
No. 2 Foundry, Valley	$25.00 to 25.00	Heavy melting steel, Valley	$22.50 to 23.00
No. 2 Southern, Birmingham	23.00	Heavy melting steel, Pitts.	22.00 to 23.00
No. 2 Foundry, Chicago	24.50	Heavy melting steel, Chicago	18.00 to 18.50
No. 2 Foundry, Philadelphia	23.76	Stove plate, Chicago	18.50 to 19.00
No. 2 Foundry, Buffalo	22.00 to 23.00	No. 1 cast, Chicago	22.50 to 23.50
Basic, valley	22.50 to 23.00	No. 1 cast, Philadelphia	20.50 to 21.00
Basic, Buffalo	23.00	No. 1 cast, Birmingham	19.50 to 20.00
Malleable, Chicago	24.50	No. 1 cast, Buffalo	20.00 to 20.50
Malleable, Buffalo	22.00 to 23.00	Car wheels, iron, Pittsburgh	20.50 to 21.00
Coke		Car wheels, iron, Chicago	21.00 to 21.50
Connellsville foundry, coke	$4.75 to 5.50	Railroad malleable, Chicago	21.50 to 22.00
Wise county foundry, coke	5.75 to 6.50	Agricultural mal., Chicago	20.50 to 21.50
		Malleable, Buffalo	22.00 to 23.00

Automotives Sound

The belief that the automobile factories within a month will be working at capacity is confidently expressed. The January output of automobiles is expected to exceed the December total, which was 303,143 and far outstrip the January, 1923, production figure of 243,539 vehicles. Shipments of automobiles are being made to increase dealers' stocks against anticipated spring demand, and orders from users, have been satisfactory. Manufacturers are buying steel and other raw materials in large quantities and are complaining of delayed shipments. Some report business on their books in sufficient volume to exceed the production of last year. In Detroit, an increase is noted in the total number of men employed in the industry. Specifications for castings are increasing and automobile foundries in general are busy. One Cleveland cylinder shop points to the steadily ascending curve representing coke receipts as a measure of the increased melt. The close of the automobile show season left a highly favorable outlook.

Pig Iron Turns

January production figures, compiled by the *Iron Trade Review*, indicate an upward trend in pig iron production for the first time since June, 1923. The total for the past month is given as 3,017,444 gross tons, which shows a gain of 104,925 tons over the December figure of 2,912,519 tons. On a daily average basis, January showed 97,337 tons per day, an increase of 3385 tons per day. The total production of merchant pig iron for the past month was 709,099 tons, which compared with December's mark of 740,624 tons shows a loss of 31,525 tons. On a daily average basis, this loss represents 1017 tons per day. The total number of stacks in blast on the last day of the month was 248, compared with 231 operating on Dec. 31. Shipments are prompt and deliveries are exceptional for the winter months. Increased demand for transportation facilities are reflected in the reduction of surplus cars. The period ending Jan. 22 showed a total of 236,174 surplus cars, a decrease of 56,747 cars compared with the previous week. Purchases of iron and coke alike are increasing, while the hurry-up order accompanies practically all requests for shipments. The same condition holds true with regard to orders for sand. Stocks of silica sand, in particular, are low and requirements are growing. December orders for malleable castings registered an advance, according to statistics compiled by the department of commerce. A total of 40,800 tons of castings was booked by 107 firms, as compared with 34,817 for November, while production was 44,586 tons for the last month of the past year. January has shown an increase in activity among malleable foundries. Orders for cast iron pipe received in December, according to the department of commerce, totaled 168,383 tons, compared with 118,995 tons for the previous month.

Nonferrous Activities

Brass foundries are busy, sustained by a steady demand for plumbing goods and nonferrous castings for the automotive lines. Prices on nonferrous metals, according to New York quotations in the *Daily Metal Trade* of Feb. 8, follow: Casting copper, 12.37½c; electrolytic copper, 12.50c; Straits tin, 53.00c; lead, 8.85c; antimoney, 10.25c to 10.50c; nickel, 32.00c; aluminum, No. 12 alloy, open market, 23.75c to 24.25c. Zinc is 6.75c, E. St. Louis, Ill. Average monthly prices for December, follow:

(New York Quotations)

Casting Copper	Electro Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
12.49	12.77	8.25	48.76	10.30	26.90	6.428

Comings and Goings of Foundrymen

PROF. THOMAS TURNER of Birmingham, Eng., has been elected president of the British Institute of Metals and will be inaugurated at the annual meeting in London March 12. Professor Turner is one of the world's leading applied scientists in the foundry field. He was the first to study scientifically the effect of silicon in cast iron. In many other ways he has contributed extensively to the technical advancement of the foundry industry. His election to the presidency of the Institute of Metals constitutes a recognition of the importance of the castings side of the nonferrous industry.

PROF. THOMAS TURNER

John F. Howard has joined the Osborn Mfg. Co. organization as sales engineer, with headquarters in Cleveland.

Fred Stockwell, treasurer of Barbour Stockwell Co., manufacturers of railroad material, Cambridge, Mass., is in California on a combined business and pleasure trip.

A. E. Greene has withdrawn from the Greene-Schaw Co., and has leased the plant formerly occupied by that company at 1302 Second street, Berkeley, Cal., and will operate a jobbing steel casting foundry.

F. H. Vose, professor of mechanical engineering, Case School of Applied Science, Cleveland, has been placed in charge of a newly organized department of George T. Trundle Jr., Engineering Co., devoted to the problems of power and fuel.

W. H. Mackey, formerly with the Washington Stove Works, Everett, Wash., and T. H. Eggers, have organized the Pacific Stove & Range Co. The firm has established a foundry at Idaho and Dwamish streets, Seattle. T. H. Eggers is president and W. H. Mackey is vice president and general manager.

A. O. Backert, who is president and general manager Penton Publishing Co., Cleveland, publisher of THE FOUNDRY, addressed the members of the Quad City Foundrymen's association at a meeting held in Moline, Monday, Jan. 21.

The Foundry Index for 1923

THE complete listing of all articles published during 1923 with cross references and an author's index has been prepared and is ready for distribution. This will be sent free upon request, to any subscriber who requests a copy through the circulation department THE FOUNDRY, *Cleveland.*

Peirce Lewis, recently appointed advertising and sales promotion manager of the Truscon Steel Co., in charge of that department in the home office in Youngstown, was formerly connected with the Kewanee Mfg. Co. and the Detroit Steel Products Co.

Arthur Congdon resigned on Dec. 1 his position as foundry superintendent with the Port Arthur Shipbuilding Co. Ltd., Port Arthur, Ont., after a continuous service of 10½ years. He is taking an extended vacation in the South and anticipates making a new connection and entering active service again about May.

W. Y. Stroh, president of the Stroh Steel Hardening Process Co., Pittsburgh, will leave about the middle of February for a European tour, during which he will give much study to foreign markets with the idea of establishing a branch plant in England.

W. A. Markwell, formerly with the Farrell Foundry & Machine Co., Ansonia, Conn., has been made foreman in charge of bench, machine and side floor work for the Bilton Machine Tool Co., Bridgeport, Conn. Thomas Anderson has been superintendent of the latter foundry for a number of years, and Mr. Markwell will act as his assistant.

James G. Pearce, who has been appointed director of research of the British Cast Iron Research association, as recently announced in THE FOUNDRY,

JAMES G. PEARCE

spent a large portion of last year visiting iron and steel works, foundries, and manufacturers of electrical machinery, in the United States and Canada. Since its inception Mr. Pearce has been a member of the council and chairman of the publications committee of the British Nonferrous Metals Research association. He is joint author with A. P. M. Fleming of the Metropolitan Vickers Electric Co., Manchester, of a recently published study covering methods of conducting scientific research with reference to its application to industry: "Research in Industry." Mr. Pearce's headquarters will be at the Birmingham office of the Research association, where he took up his new duties Feb. 1.

Kenneth Hamblin has been appointed assistant to the general manager of the Rhode Island Malleable Iron Works, Hillsgrove, R. I. For the past two years Mr. Hamblin has been inspector in the research department of the Ameri-

can Malleable Castings association and prior to that time he was in the laboratory of Enrique A. Touceda at Albany, N. Y.

Huntley Gordon, Hamilton, Ont., has been elected a director of the Dominion Foundries & Steel, Ltd., that city. He succeeds William Harty Jr., of Kingston. Mr. Gordon was graduated from mechanical engineering school of Dalhousie university, Halifax, N. S., and Cornell university. For some years he was connected with Niles Bement Pond Co., New York.

A. Rhydderch who has been connected with the research and technical staff of Hadfields Ltd., Sheffield, Eng., has resigned to accept the management of the Abbeydale steel foundry of Robert Hyde & Sons, Ltd., Sheffield. Under Mr. Rhydderch's direction a specialty will be made of the production of high permeability steel castings for electrical purposes in addition to steel castings having standard qualities.

Gustave Masson, foundry manager at Chenee, Liege, Belgium, has been elected president of the Association Technique de Fonderie de Liege. Joseph Leonard, the former president, has resigned on account of his new business connection having obliged him to change his residence from Liege to Farciennes. M. Leonard will remain on the committee of the Association Technique de Fonderie de Liege, which is the leading Belgian foundrymens' organization.

B. R. Gyllenram, assistant manager, and Sven Nilsson, foundry superintendent, Husqvarna Vapenfabriks A. B., Huskvarna, Sweden, a large foundry interest manufacturing light castings, stove plate and sanitary ware, are touring the foundry centers from Boston westward to Milwaukee and St. Louis. They are making a detailed study of foundry practice and equipment with the particular view to the applications in their own plant. They expect to remain in the United States until early in March.

Joseph E. Fletcher, consulting engineer, Dudley, England, has been appointed consultant to the British Cast Iron Research association. Mr. Fletcher is one of the leading British iron, steel, and foundry engineers. During the organization stages of the Cast Iron Research association he temporarily occupied the position of director of research which his numerous business affiliations prevented him from continuing. As consultant his services will still be available to the research association, especially for dealing with the practical side of cast iron and malleable castings research. For a number of years Mr. Fletcher was foundry manager for Thomas Firth & Sons, Ltd., and Cammell Laird & Co., Ltd., Sheffield. He has specialized in questions relating to the design of castings and molding sands. At present he is also consulting metallurgical engineer for N. Hingley & Son, Ltd., chainmakers, Dudley, England.

Lloyd W. Smith, president of the Union National bank, Pittsburgh, was elected a director at the stockholders' meeting of the Pittsburgh Steel Foundry Co., Jan. 29. His father, Robert S. Smith, at one time president of the Union National bank, was one of the organizers of the Pittsburgh Steel Foundry Co., and served as a director in the organization until his death. Mr. Smith takes the position made vacant by the death of Capt. Hugh Moren. The other directors reelected are: Frank A. McCune, Harry Darlington Jr., James H. Lockhart, J. M. Lockhart and Stewart Johnston.

Obituary

James Findlay, for 18 years superintendent of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., died at his home in that city, Dec. 20. He was 62 years of age. Previous to his connection with the Birdsboro company, Mr. Findlay had been superintendent of the plant of the Philadelphia Roll & Machine Co., Philadelphia.

William T. Stubbs, chairman of Joseph Stubbs, Ltd., Openshaw, Manchester, iron founders and manufacturers of textile machinery, died at Bournemouth, England, on Dec. 13 at the age of 66. Mr. Stubbs is survived by his brothers, among whom is Oliver Stubbs, president of the Institute of British Foundrymen. Until recently Mr. Stubbs was actively engaged in business. He was at one time president of the Manchester chamber of commerce and was unusually prominent in business affairs in the north of England.

Stephen C. Mason, aged 52 years, secretary and director of the McConway & Torley Co., Pittsburgh, a nationally known commercial traffic expert, died Dec. 12 in his home in that city. He was born in Fairlee, Vt., Feb. 1, 1861. For 10 years he served as assistant statistician of the interstate commerce commission at Washington. He came to Pittsburgh in 1899, when he was made secretary of the McConway & Torley Co. From 1919 to 1921 he served as president of the National Association of Manufacturers. At one time he was vice president of the Railway Business association and served a term as vice president of the National Founders' association.

M. Cerula Woodbury, known as the only woman manager of a structural steel plant and foundry in the United States, died at her home in Great Falls, Mont., recently. Miss Woodbury was assistant to her father, L. S. Woodbury, founder of the Great Falls Iron Works, which was established in 1890. For more than 27 years she was a director in the corporation. In 1898 she was elected secretary-treasurer and in 1907 she gradually took over executive responsibilities which devolved upon her, due to her father's failing health. In 1918 she became president and treasurer of the company and was its active directing head until her death recently.

Thomas K. Lent, foundry superintendent for the William M. Crane Co., Jersey City, N. J., died recently at his home in Peekskill, N. Y., after an illness of seven months, aged 59 years. Mr. Lent had been virtually identified with one interest for more than 44 years, becoming associated in 1879 with the Peekskill Stove Works, which in 1898 was purchased by the Crane company. At the time of the absorption, he was promoted from foundry foreman to superintendent, the position he held at the time of his death. Mr. Lent was born in Brooklyn, but at an early age went with his parents to Peekskill. When the Crane company moved its plant from Peekskill to Jersey City in 1910, he continued to maintain his home in that city.

William Hoopes, aged 57, head of the research and technical department of the Aluminum Co. of America, Pittsburgh, died Jan. 9 at his home in that city. The introduction of aluminum for electrical purposes, particularly for high voltage transmission, is credited to the efforts of Mr. Hoopes. He placed in successful operation many chemical and metallurgical operations which caused him to be recognized everywhere as an authority in aluminum metallurgy. Mr. Hoopes was born in West Chester, Pa., and was educated in the public schools of West Chester and Philadelphia. Later he was graduated from the school of electrical engineering of Lehigh university. For 10 years after graduation he was engaged in the construction of electric railways. He then came to Pittsburgh and joined the staff of the Westinghouse Electric & Mfg. Co. He became chief electrical engineer of the Aluminum Co. of America in 1900 and for the last seven years had been head of the research and technical departments.

Develops a New Rapid Type Molding Machine

Several unique features have been incorporated in a machine for light work recently placed on the market by the Osborn Mfg. Co., Cleveland and shown in the accompanying illustration. The machine is presented in two forms, one as shown and the other mounted on three large wheels. The first type is designed for use in a fixed position where the sand is supplied from a chute or in any other manner. The second type, provided with the wheels, is designed for use where the sand is prepared in long windrows and where it is desirable to set the molds in long rows. The machine is placed at the front of the floor in the morning and moved steadily backward as the sand is consumed.

THE SWINGING HEAD SUPPORTED ON TWO UPRIGHT ARMS EASILY IS MOVED FORWARD AND BACK

Absence of side strain rods permits the use of comparatively long flasks where occasion may arise for their use. The squeezer head is provided with four bolt holes for attaching a board of any required size. The outstanding features of the machine are the swinging head and the pop valve which automatically regulates the pressure on the mold. The steel head is mounted on two upright arms in such a manner that it may be brought forward over the table or pushed back out of the way with a minimum of effort. A long flat spring attached to the back upright regulates the balance. A steel casting in the front upright furnishes the necessary strength to resist the squeezing force exerted against the head. The back upright which has to withstand a downward compressive force is made of cast iron. In effect, the squeezer head is a lever with the front end over the flask, the fulcrum a steel pin in the front arm and the back attached to a pin in the backarm. The pins are knurled at one end and provided with cotter pins at the other end and easily are slipped in and out when it becomes necessary to lift or lower the head to accommodate flasks of various heights.

The air line leading to the bottom of the cylinder is provided with a pressure gage and a pop valve that may be set to secure any desired pressure. This valve is attached to the line close to the gage and at a convenient point for the attention of the operator. In practice the curved handle shown over the squeezer head is grasped by the operator and pulled forward until the head automatically is brought to a stop directly over the table. By pulling down on the same handle, air is admitted to the cylinder and the table containing the flask is pushed up against the squeezer head. When the handle is released the air supply is shut off, the air in the cylinder is exhausted and the squeezer head is pushed back out of the way.

Foundry Problems on Convention Program

The seventh annual convention of the Southern Metal Trades association will be held in New Orleans, La., Feb. 26-27, the headquarters of the convention being at the St. Charles hotel. The program in part is as follows:

TUESDAY, FEB. 26

Afternoon Session

Address, President J. R. Hedges, Chattanooga, Tenn.; Appointment of committees; "Tinkering with the Transportation Act," by E. S. Jouett, vice president, Louisville & Nashville Railroad Co., Louisville, Ky.; "Miscellaneous Details in Connection with Gray Iron Foundry Practice," by Enrique Touceda, consulting engineer, Albany, N. Y.

Evening Session

Banquet, W. G. Mealor, ex-president of Southern Metal Trades association, toastmaster; "The Port of New Orleans," by N. M. Leach, president, Pacific-Carribean Gulf Line, Inc., New Orleans.

WEDNESDAY, FEB. 27

Morning Session

Reports of officers: Report of treasurer; "Foundry Costs," by Thomas Perkins, Macon, Ga.; "Problems of Management in a Jobbing and Manufacturing Plant," by W. C. Trout, Lufkin, Tex.; "A Comparison of American and European Foundry Practice," by H. M. Lane, Detroit; reports of committees; election of officers.

Wednesday afternoon will be devoted to trips around the city, visiting French quarters and other points of interest.

Consider X-Ray Work

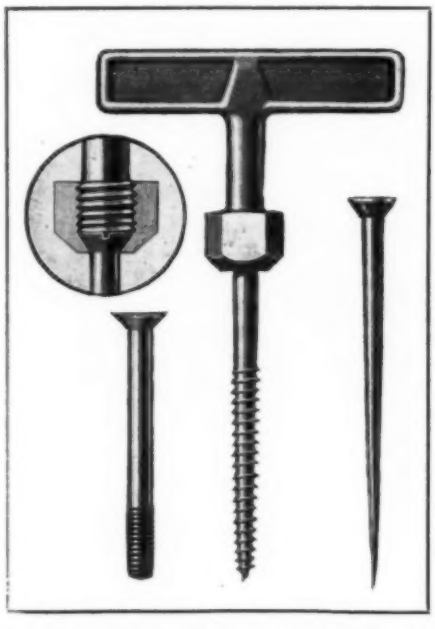
Work being done at the Watertown arsenal in connection with the examination of steel castings by X-rays was discussed in a paper "X-Rays and Steel" presented by Dr. Ancel St. John, research laboratory, Union Carbon & Carbide Co., Long Island City, N. Y., at the winter sectional meeting of the American Society for Steel Treating held at the Hotel Seneca, Rochester, N. Y., Jan. 31-Feb. 2. In beginning the paper Dr. St. John explained the molecular and electron theory of matter which makes examination by X-ray possible. A portable X-ray apparatus was set up and operated and the relative sensitivities of wood, aluminum, steel and lead demonstrated.

Numerous lantern slides were used

to show results obtained from tests. In pointing out the application of X-ray examination to large-scale work in a practical way, the speaker showed numerous slides of tests conducted at the Watertown arsenal. A number of heavy cast steel ordnance castings were examined by means of a powerful X-ray apparatus. Castings of this class must combine maximum strength with minimum weight, thus it is essential that interior defects be eliminated. The castings were found to contain so many blowholes and gas pockets that they were unserviceable. Naturally attention was turned to molding and pouring with the result that by modifications in the method of gating and placing risers in the molds, almost perfect castings were produced Dr. St. John pointed out.

Combination Draw Screw

Details of construction of an interchangeable screw device for drawing patterns out of the sand are shown in the accompanying illustration. The handle is nicely rounded and a convenient size to fit the hand. The lower end terminates in a thread which engages a hexagon nut and when driven down tightly holds the screw firmly in place. Each handle is provided with a wood screw, a standard threaded bolt for drawing metal patterns and a sharpened spike for light wood patterns. To change from one form of drawing equipment to another it is only necessary to remove the nut and afterward replace it. The device is manufactured by the Will-Burt Co., Orville, O.



HANDLE WILL HOLD EITHER A WOOD SCREW, AN IRON SCREW OR A DRAW SPIKE

Resigns from Machine Manufacturing Firm

Wm. D. Fraser has resigned his position as manager of the Berkshire Mfg. Co., Cleveland, maker of molding machines and vibrators. Mr. Fraser has been in charge of the manufacturing operations for this company since 1911. He has made his home in Cleveland for 40 years. His first employment was with the Cummer Engine Works, now the Kilby Mfg. Co., when the former plant built steam engines. After leaving the Cummer company Mr. Fraser was employed as a machinist by the Brown Hoisting Machinery Co. for four years, leaving to take charge of the Cleveland-Gordon Press Co., manufacturer of printing presses.

After two years Mr. Fraser embarked upon printing machinery manufacturing by establishing the Fraser Machine Works, now the Industrial Machine Works. After disposing of his interest in that company he was employed for a short time by the Van Loozen Color Press Co. of Bucyrus, when he returned to Cleveland to assume charge of the Berkshire Mfg. Co.

Elect New Officers to Chicago Club

The Chicago Foundrymen's club at a meeting held Saturday, Jan. 19, elected the following officers for the ensuing year: President, Eugene W. Smith, Crane Co.; vice president, G. P. Fisher, Whiting Corp.; secretary-treasurer, Gilbert L. Lacher, *Iron Age;* directors, James A. Murphy, Wolff Mfg. Co., Charles L. Larson, Armor institute, Carl M. Pearson, Pickands-Brown & Co., and J. H. Hopp, Charles C. Kawin Co. Mr. Hopp was appointed representative for the Chicago Foundrymen's club on the joint sand research committee of the American Foundrymen's association and the National Research council.

Cost Association Names New Directors

Directors recently were elected for the 1924 term for the Industrial Cost association, Pittsburgh of which A. A. Alles Jr., Schaffer Engineering & Equipment Co., that city, is secretary. The list of the new directors follows: George W. Sheridan, assistant treasurer, West Leechburg Steel Co.; Charles S. Garrison, treasurer, the Sutton Press; James P. McLean, auditor, Pittsburgh Forge & Iron Co.; W. W. Holsinger, auditor, Lewis Foundry & Machine Co.; James E. Smith, National Tube Co.; W. F. Menk, cost accountant, Pittsburgh Water Heater Co.; Fred E. Harlan, National Tube Co.; J. F. Johnston, auditor, Oliver Iron & Steel Corp.; A. D. Lowdermilk, auditor, Standard Seamless Tube Co.; H. J. White, secretary, H. L. Dixon Co.; R. S. Porter, manager of production, McConway & Torley Co., and C. Leslie Phebus, accountant, S. Strunz & Son.

HEAVY DUTY TRACTOR FOR USE IN CONNECTION WITH A TRAIN OF TRAILERS

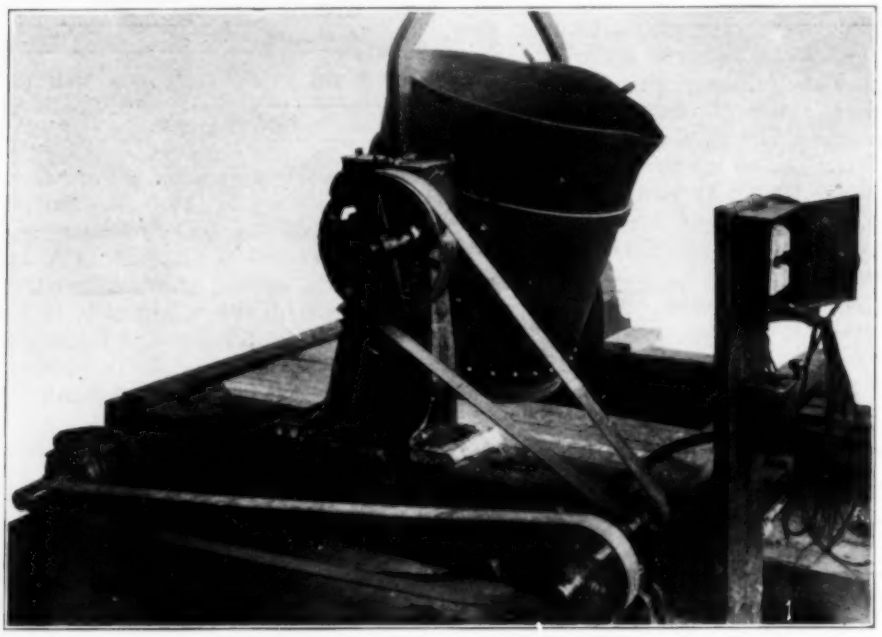
Tractor for Foundry Use

For the purpose of hauling heavier loads than those within the capacity of its former product the Crescent Truck Co., Lebanon, Pa., has developed the truck shown in the accompanying illustration. Where a sufficient number of trailers are provided it is claimed that the tractor may be employed constantly in hauling a loaded train while a second train is being either loaded or unloaded. The tractor is equipped with heavy steel bumpers front and rear, is driven on the two rear wheels and steered on the two front wheels. It has a total length of 80½ inches, a total height of 52½ inches and a width of 44 inches. Other features include a speed of from 5 to 8 miles per hour, ultimate drawbar pull of 2400 pounds, a wheel base of 42 inches and a total weight without battery of 2250 pounds. The controller provides for three speeds forward and reverse, the external contracting brake on the drive shaft is operated by a foot pedal and the safety switch circuit automatically is broken when the driver leaves his seat.

Tests Ladle Tilting Rig

To determine the wearing ability of its worm gearing for tilting foundry ladles, as well as the power required to operate it, the Whiting Corp., Harvey, Ill., recently devised a special testing apparatus. An 8000-pound capacity crane ladle was set in a pair of standards arranged so that the ladle could revolve continuously in either direction, as shown in the accompanying illustration. A standard

helical worm gear bracket was mounted on the ladle trunnion; the handwheel was removed and replaced by an 18-inch pulley. A 2-horsepower motor was set to drive the ladle through a jackshaft so that the handwheel shaft was running approximately 94 revolutions per minute. With a gearing ratio of 58.27 to 1, the ladle revolved at the rate of 1.6 revolutions per minute. A



6000 REVOLUTIONS WERE TAKEN AS THE EQUIVALENT OF 10 YEARS SERVICE

revolution counter was mounted on the idler trunnion of the ladle and a recording wattmeter was placed in the motor circuit to show graphically the power required to drive the ladle at all times.

A counterweight consisting of round steel plates weighing 500 pounds was attached to the bottom of the ladle, this weight being sufficient to put a load on the gearing equivalent to the maximum load encountered while using this same size ladle in the foundry. During the test it was found that maximum power was required only at one point during the revolution of the ladle when the counterweight was at its greatest horizontal distance from the center of the trunnion. Starting with the ladle in a vertical position with the counterweight at the bottom and turning it 90 degrees required approximately the same amount of work for the gearing to perform as if the ladle had been used to pour its capacity of molten metal. On this basis, one complete revolution of the ladle during the test was equivalent to using it twice in the foundry.

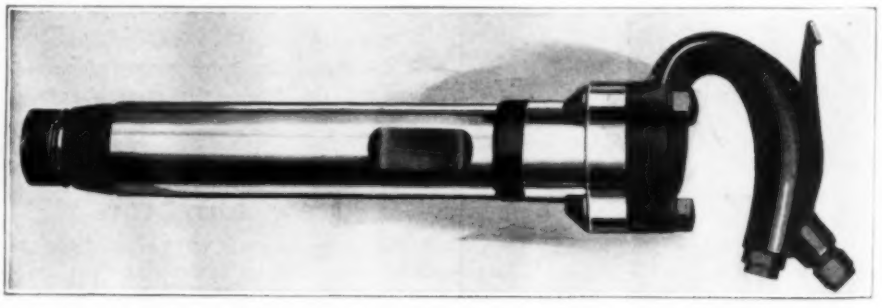
After 6000 revolutions of the ladle, or the equivalent of about 10 years service in the average foundry, the bronze bushings in the bracket were examined and found to be smooth and worn down only a few thousandths of an inch. In this connection it should be noted that the pressure on the bearings of the handwheel shaft, due to the weight of the pulley and the tension of the belt, was several times as great as would occur in ordinary operation. The power input to the motor averaged 0.8 kilowatts at the peak and 0.2 kilowatts while the counterweight was traveling downward. The conclusion reached by the tests was that barring accidents and assuming ordinary attention to lubrication, the ladle tilting device would outlast the ladle to which it is attached.

Designs Rivet Hammer

The Ingersoll-Rand Co., 11 Broadway, New York, has developed a new type of pneumatic riveting hammer, the outstanding features of which are bolted construction for holding the handle of the barrel, heavy section valve with liberal bearing surfaces, combination poppet and piston type throttle valve, power in excess of ordinary requirements, low air consumption and easy operation.

This model of hammer is manufactured in three styles and is available in range of sizes from a 5 to 9-inch stroke. Three alloy steel bolts fitted with lock washers, hold the handle to the barrel. The throttle valve, except on models with inside trigger handles, is a combination of the piston and poppet types. The beveled seat, it is claimed, will remain tight throughout the life of the tool, preventing leakage. The throttle lever or trigger is made in one piece from special heat treated spring steel and has a long bearing in the handle, making it capable of withstanding lots of abuse. The control is sensitive, ranging from a light tap to a heavy blow, entirely at the will of the operator.

The valve is a sturdy sleeve made from special alloy steel. It operates in a valve box, located in the head of the barrel. The valve box is constructed with a solid end which enables it to be taken apart easily. The handles are drop forged to a shape that fits the hand and are sandblast finished. Either outside or inside trigger handles can be furnished, although the outside type is standard.



NEW TYPE PNEUMATIC RIVETING HAMMER DEVELOPED BY THE INGERSOLL-RAND CO.

Will Hold Exhibit

An exhibition of foundry machinery and equipment will be held in Birmingham, Eng., June 19 to 28 under the auspices of the Birmingham chamber of commerce which managed the successful exhibition held in 1922. A committee of prominent British engineers and foundrymen is being formed to assist in the technical organization of the exhibition.

The membership of the German foundrymen's association diminished somewhat during the past year, for the first time since its foundation, owing to present conditions in Germany. At the end of December 1923, the membership was 6066 compared with 6329 at the end of 1922. Included in the figure for 1923 are 469 new members who joined during the year.

Acceleration in Orders Noted

Interest Quickens as New Projects and Foundry Additions Requiring Equipment Are Reported—January Sets Pace in Inquiries and Volume of Business Placed

JANUARY proved exceptional in foundry equipment lines. Orders were large, inquiries showed an increase and of the latter the number which may be classed with probable orders, was satisfactory. This was particularly true among molding machine and cleaning room equipment manufacturers. Foundry additions and extensions are projected in a number of sections. In New England, the Rhode Island Malleable Iron Works, Hill's Grove, R. I., and the Chapman Valve Mfg. Co., Indian Orchard, Mass., are reported contemplating enlarged facilities. Nickel Plate Foundry Co., 14915 Woodworth road, Cleveland, C. M. Bolich, manager, is planning an addition, while the Bowler Foundry Co., 1688 Columbia road, Cleveland, soon will let the contract for a new foundry, being forced to abandon the present location through the encroachment of the new union station project. J. H. Bruce is the manager of the Bowler plant. Recent sales of cleaning mills by the W. W. Sly Mfg. Co., Cleveland include units for Henry Furnace & Foundry Co., Medina, O., Cleveland Co-operative Stove Co., Cleveland, and Gray & Dudley Mfg. Co., Nashville, Tenn. Frazer & Jones Co., Syracuse, N. Y., has purchased a core sand reclaiming mill and the Dayton Malleable Iron Co., Dayton, O., has placed an order for dust arrester equipment with the Sly company. The Erie Forge Co., Erie, Pa., has purchased sand blast equipment from Pangborn Corp., Hagerstown, Md.

Sales Adequate in Pittsburgh Region

EXPECTATIONS of good business in foundry equipment are being realized in many directions, although in others, orders continue held up. Molding machine manufacturers have taken a large number of orders from car wheel manufacturers, sanitary ware producers and other large jobbing foundries; a few purchased groups but the majority of recent orders have been for single installations. The Whiting Corp., Harvey, Ill., has booked a number of cupola, ladle and tumbling barrel orders and other manufacturers likewise have taken a few orders for similar equipment. The W. H. Cain Gas Radiator Co., Los Angeles, has ordered a cupola, and the Studebaker Corp., South Bend, Ind., purchased cupola charging machinery from that maker. The Odin Stove Mfg. Co., Erie, Pa., the Clark Equipment Co., Buchanan, Mich., and the Eagle Foundry & Machine Co., Muskegon, Mich., have ordered tumbling barrels from the Whiting Corp. The same manufacturer took an order from the Michigan Steel Castings Co., Detroit for a 9500-pound ladle; the Milford Iron Foundry, Milford, Mass., bought a 7-ton crane ladle, while the A. O. Smith Corp., Milwaukee, bought some ladle equipment and the Sawbrook Steel Castings Co., Cincinnati, closed on four 3-ton ladles. The Whiting company sold a cinder mill to the J. L. Mott Iron Works Co., Trenton, N. J. The National Cast Iron Pipe Co., bought two 3-ton handpower cranes; and the American Brake Shoe & Foundry Co., Chicago, closed on 6 hoists. The Co-operative Foundry Co., Rochester, N. Y., bought a 2-ton single I-beam crane with 28-foot span from the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., while the Sheffield Foundry Co., Chicago, closed on a 10-ton electric traveling crane with Alfred Box & Co., New York. Cranes for the Standard Sanitary Mfg. Co.'s new plant at Baltimore, will be purchased shortly including five for the foundry and one for the machine shop, all 5-ton capacity, together with electric furnace, machine tools and a large quantity of other foundry equipment within a week or so. The Westinghouse Electric & Mfg. Co., has a large list of equipment out for East Pittsburgh, has purchased a number of small items for various service stations and is understood to be contemplating large purchases for its additional capacity to be erected at Sharon, Pa. Bids now are being taken on about 5000 tons of structural steel for this expansion. The Reading Casting Co., Reading, Pa. and McConway & Torley Co., Pittsburgh, have ordered sand blast equipment from the Pangborn Corp., Hagerstown, Md.

Light Orders in Chicago District

FOUNDRY equipment sales still lag somewhat, probably in step with foundry business in the Chicago district. Foundries working on automobile castings are active but the jobbing foundries could handle more work. Cupola sales of the Whiting Corp., Harvey, Ill., include one each to the J. L. Mott Co., Trenton, N. J.; the National Cast Iron Pipe Co., Birmingham, Ala.; Haynes-Langenberg Mfg. Co., St. Louis; Carbon Steel Castings Co., Lancaster, Pa.; Indiana reformatory, Pendleton, Ind.; and the Ford Motor Co., Detroit. Crane Co., Chicago, has purchased two batteries, of four each, of 52 x 56 inch and the Ypsilanti Foundry, Ypsilanti, Mich., two 24 x 36-inch tumbling barrels from the same maker. Recent sales of the National Engineering Co. include sand mixers to the Frog & Switch Mfg. Co., Carlisle, Pa., and S. F. Bowser & Co., Ft. Wayne, Ind. The Banner Iron Works, St. Louis, Holmes Foundry Co., Port Huron, Mich., and the Studebaker Corp., Detroit, have purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md. Among recent sales of cleaning mill equipment are units ordered from the W. W. Sly Mfg. Co., Cleveland, by Wilson Foundry & Machine Co., Pontiac, Mich., St. Clair Foundry Co., Belleville, Ill., and W. D. Allen Mfg. Co., Chicago.

Improvement Noted in Eastern Market

WHILE getting under swing more slowly than last year, the trading in foundry equipment is steadily improving. New construction work is more in evidence, and foundries are operating on an increasing scale, these developments being felt throughout the trade. Recent business has included several orders for cranes and other conveying equipment. A particularly interesting order is that of the General Fire Extinguisher Co., Providence, R. I., involving a conveyor installation for the handling of sand and molds at its Warren, O., plant. The order approximated $85,000 and went to the Lamson Co., Boston. An additional unit is to be purchased later. The J L. Mott Co Trenton, N. J., has closed on a 5-ton electric crane, 41-foot span, to the Whiting Corp., Harvey, Ill., and the Hart & Crouse Co., Utica, N. Y., has purchased a used 23-ton McMyler crane, for service in its

yard, from Philip T. King, 30 Church street, New York City. The J. L. Mott Co., Trenton, N. J., has placed orders for equipment with other sellers. Plans have been completed by the Boynton Furnace Co., Jersey City, N. J. for the erection of a new foundry, and construction is expected to get under way shortly. The Singer Mfg. Co., Elizabethport, N. J., has purchased additional cupola charging equipment from the Whiting Corp., which has also booked an order through the F. D. Chase Co., Chicago, for two 12-ton cupolas for the Carbon Steel Castings Co., Lancaster, Pa. The West Chester Steel Products Co., West Chester, Pa., recently organized has purchased the plant of the West Chester Railway Co. at Lenape, Pa., which it will remedol for the manufacture of manhole covers, flanges, etc. The foundry owned by the Pennsylvania railroad at Lancaster avenue and Fiftieth street, Philadelphia has recently been purchased by the Keystone Roller Bearing Co., Inc., which will also make some alterations incident to operating for its own use. Plans have been completed by the Hartford Stove Repair Co., Hartford, Conn., for the erection of a $40,000 addition. The American Malleables Co., Lancaster, N. Y. and the Trenton Emblem Co., Trenton, N. J., have purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Westinghouse Machine Co., Attica, N. Y., plans constructing 1-story foundry.

Smith Facing & Supply Co., 1857 Carter road, Cleveland, is building 35 x 96-foot, 1-story building for manufacture of foundry supplies.

E. Bessette, 540 Labreque street, Montreal, Que., is asking for tools and complete equipment for foundry.

Athens Foundry & Machine Co., Athens, O., has been sold to E. E. Jacobs. The plant is to be enlarged and remodeled.

A. Archambault, 3520 Henri Julien avenue, Montreal, Que., will purchase complete equipment and is receiving quotations.

J. Dale, 15 Concord street, Montreal, Que., is asking for prices on tools, machinery and complete equipment for brass foundry.

Sudbury Construction & Machinery Co., Sudbury, Ont., operator of gray iron, brass and aluminum foundries, plans rebuilding machine shop recently damaged here by fire.

Parsons Machinery Co., Marlboro, Mass., manufacturer of shoe machinery, will operate its foundry in the future under the name of the Marlboro Foundry Co., as a jobbing plant.

Everett Bedstead Foundry Co., Brooklyn, N. Y., has been incorporated for $5000 by L. and F. and R. Rosengarten, with D. Rosengarten, 565 West 189th street, New York, as attorney.

Nutley Foundry Co., manufacturer of brass, bronze and aluminum castings, has moved from 16 Stager place, Nutley, N. J., to Princeton street and Passaic avenue, Passaic, N. J.

Greene-Steel Castings Co., Berkeley, Cal., has taken over the plant of the Greene-Shaw Co., 1302 Second street, and now is manufacturing steel castings.

Westinghouse Electric & Mfg. Co. directors have approved plans for enlarging works at Sharon, Pa., extension to include a modernly equipped foundry.

Wickham Piano Plate Co., Springfield, O., has awarded construction contracts to H. K. Ferguson Co., Cleveland, for building 1-story, 62 x 195-foot brick and steel foundry.

L. H. Goodnow Foundry Co., Fitchburg, Mass., manufacturer of gray iron castings, was damaged by fire recently with loss to the pattern department.

Galt Machinery & Screw Co., Ltd., Galt, Ont., has been incorporated for $500,000 to take over and operate the business of the Galt Machine Screw Co., Ltd., to manufacture machinery, tools, dies, etc., and to carry on a general foundry and machine shop business, by Richard W. Roelofson, Carl K. Jensen and Chauncey E. A. Fowler.

Republic Brass & Mfg. Co., 1931 Violet street, Los Angeles, has let contracts for constructing 2-story plant on Twenty-seventh street, for the manufacture of brass and bronze castings.

The Pennsylvania Engineering Works, Inc., New Castle, Pa., plans installation of equipment following recent increase in capitalization from $1,000,000 to $1,300,000. The company makes iron and steel castings.

Peckham Brass Foundry, Inc., Boston, has been incorporated for $10,000 to make brass and bronze castings, with Gustavus H. Sparrow, 10 Willow street, Belmont, Mass., as president and treasurer.

Riverside Welding & Brazing Works, Riverside, Cal., Fred Pittam, president, has purchased a site at 620 Market street, where it plans 1-story building. New equipment will be installed.

Canadian Steel Foundries, Ltd., Longue Pointe, Que., plans addition to foundry building to cost about $8000 and has awarded general contract to H. C. Johnston, Ltd., 260 St. James street.

Wilson & Cousins, Ltd., Toronto, Ont., has been incorporated for $100,000 to carry on business of brass founder and metal worker, by Joseph M. Bullen, Norman B. Stirrup, John F. Lucas and Craig McKay.

Florida Machine Works, Jacksonville, Fla., is building a 1-story machine shop which will require an electric traveling crane and other equipment. A warehouse and foundry recently were completed. W. T. Londeree is superintendent of construction.

Theron Automatic Oil Burner Co., Ltd., Bridgeburg, Ont., has been incorporated for $100,000 to manufacture oil burners, stoves, furnaces, radiators, etc., by James E. Humes, Nichols, Ga.; George G. Gregory and Augusta E. Grimm, Buffalo, N. Y.

Pacific Stove & Range Co., Seattle, organized recently by W. H. Mackey, formerly with the Washington Stove Works, Everett, Wash., and T. H. Eggers, plans establishment of foundry at Idaho and Dwamish streets. The company will specialize in stove work.

Jensen, Nehls & Co., 3601 West North avenue, Chicago, has been incorporated with 100 shares no par value stock to manufacture and deal in mill, foundry and factory supplies and hardware, by R. H. Nehls, Stuart Aagaard and H. G. Jensen.

Clarke Bros. Machinists, Ltd., Toronto, Ont., has been incorporated for $50,000 to carry on general machine shop and foundry business and to manufacture tools, machinery and other iron and steel and metal products, by William H. McGuire, James A. Boles and Eric G. Moorehouse.

Welland Steel Castings, Ltd., Welland, Ont., recently noted as incorporated, has taken over the plant of the Welland Machine & Foundry Co. and will install electric furnace equipment for manufacture of electric steel castings. H. D. Davison is president of the new company, E. S. Davison, vice president, and C. M. Carmichael, general manager and secretary.

Crouse & Pope Foundry Corp., Auburn, N. Y., recently purchased the No. 1 foundry formerly owned by International Harvester Co. there. The Crouse company was incorporated for $100,000 a short time ago and now is equipped to do business in light and medium castings with from 50 to 75 tons a day capacity. The plant now is partially equipped. William Crouse is president, William J. Emery, vice president, H. L. Hope, treasurer, and E. G. Washburn, secretary.

New Trade Publications

FLASKS—The J. S. McCormick Co., Pittsburgh, Pa., recently has issued a bulletin of foundry flasks. Newer types of snap, taper and steel flasks and allied equipment are shown.

ACETYLENE—The Air Reduction Sales Co., 342 Madison avenue, New York, have published a 10-page pamphlet in which is discussed the various factors governing the proper methods for caring for oxygen and acetylene cylinders.

CRANES—The Whiting Corp., Harvey, Ill., has published a folder in which is included a list of some of the numerous power house installations made by this company, a description of some of the parts of power house cranes and views of the parts mentioned.

PULVERIZING EQUIPMENT—The Fuller-Lehigh Co., Fullerton, Pa., has issued a 24-page booklet describing and illustrating several types of pulverizing mills, crushing rolls, drier, equipment for conveying pulverized material, pulverized coal burners, air systems, feed controllers, and gages.